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SALMON SPAWNING GROUND SURVEYS

IN THE BRISTOL BAY AREA, ALASKA, 1999

by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF APPENDICES (Continued)

INTRODUCTION

Aerial surveys of salmon spawning streams have been conducted in the Bristol Bay area of Alaska (Figure 1) for many years. Surveys provide biologists with information regarding the abundance and distribution of sockeye salmon *Oncorhynchus nerka*, chinook salmon *O. tshawytscha*, chum salmon *O. keta*, pink salmon *O. gorbuscha*, and coho salmon *O. kisutch* escapements. This information is important to fishery managers for several reasons. It supplements data gathered at counting towers on the mainstem rivers, provides data from rivers where counting towers are not utilized, and provides data for time periods and species not covered by counting tower operations. Collected information is used to: (1) evaluate escapement goals and escapement/return relationships, (2) forecast future returns, (3) identify possible management problems relating to escapements, and (4) contribute to strategies designed to alleviate escapement problems. This report summarizes the 1999 salmon spawning ground surveys conducted in the Bristol Bay area.

Naknek/Kvichak District

Naknek-Kvichak District is comprised of three major rivers: (1) the Kvichak River, issuing from Iliamna Lake and its tributaries, (2) the Alagnak or Branch River flowing from Kukaklek and Nonvianuk Lakes, and (3) the Naknek River emanating from Naknek Lake and its tributaries (Figure 2). All of these systems flow into Kvichak Bay.

Since 1955, Kvichak River sockeye salmon escapements have been estimated using counting towers located on the Kvichak's mainstem, approximately one-quarter mile downstream of Lake Iliamna's outlet. From 1957 to 1976, Alagnak River sockeye escapements were estimated using a counting tower located near the upper extent of tidal influence. Since 1977, all Alagnak sockeye escapements have been estimated using aerial surveys. From 1950 to 1957, sockeye escapements to the Naknek River system were counted using a weir on the mainstem of the river just upstream of the tidal influence. From 1958 to the present, escapements have been estimated using counting towers near the Naknek River 'Rapids' downstream of the outlet of Naknek Lake. Escapement of other salmon species into Naknek-Kvichak District drainages has been estimated using aerial surveys.

Egegik District

Egegik River system contains two major watersheds: (1) the Egegik River, emanating from Becharof Lake and nearby coastal lowlands, and (2) the King Salmon River, issuing from runoff from the Kejulik Mountains and southern portions of Katmai National Park (Figure 3). Both rivers flow into Egegik Bay near the village of Egegik.

From 1952 through 1956, a weir was used in the Egegik River to count sockeye salmon escapements. The weir was located near the base of the Egegik River 'rapids'. From 1957 to the present, counting towers situated between the outlet of Becharof Lake and Egegik Lagoon have

been used to estimate sockeye escapements. Escapements for other salmon species have been estimated using aerial surveys.

Ugashik District

The Ugashik River system consists of four major watersheds: (1) the Ugashik River, flowing from Lower Ugashik Lake and nearby coastal lowlands, (2) the Dog Salmon River, emanating from glacial melt and runoff from peaks in the Aleutian Range, (3) the King Salmon River, issuing from Mother Goose Lake and three major runoff tributaries, and (4) Dago Creek, emitting from a large lowland coastal area (Figure 4). All of these systems flow into the intertidal reaches of Ugashik River and Ugashik Bay.

From 1949 to 1956, a weir located downstream from the outlet of Lower Ugashik Lake was used to count sockeye salmon escapements. From 1957 to the present, sockeye escapements have been estimated using counting towers located between the outlet of Lower Ugashik Lake and Ugashik Lagoon. Escapements for other salmon species have been estimated using aerial surveys.

Nushagak District

Nushagak watershed is comprised of four major rivers: (1) the Wood River, draining Grant, Kulik, Beverley, Nerka, and Aleknagik Lakes, (2) the Nushagak River, draining Tikchik Lakes and the Nuyakuk, upper Nushagak, and Mulchatna Rivers, (3) the Igushik River, draining Ualik and Amanka Lakes, and (4) the Snake River, draining Lake Nunavaugaluk (Figures 5 through 8). All of these systems empty into Nushagak Bay.

Abundance and age composition of sockeye salmon escapements in the Wood River Lake system has been estimated annually from counting towers at the outlet of Lake Aleknagik since 1953.

Sockeye salmon distribution in the Wood River Lake system is an important element in establishing escapement goals and measuring success in achieving escapement goals for this system. Interconnecting rivers between the large lakes in the system are primarily used by three-ocean sockeye for spawning, while the lake beaches and tributary streams are used more by two-ocean sockeye. Knowledge of the age composition of returning sockeye gives managers the ability to use a variable escapement goal policy to minimize overcrowding of spawners in the interconnecting rivers while taking advantage of the extensive beach spawning areas and numerous tributary streams.

Each year, ADF&G personnel conduct aerial surveys to assess sockeye spawner distribution within the Wood River Lake system. Personnel from the University of Washington, Fisheries Research Institute also conducted ground surveys on major creeks and some rivers of the system. Surveys of the actual spawning distribution within the creeks, rivers, and beaches of the system provide a measure of management success in obtaining the desired spawning distribution.

Salmon escapement in the Nushagak River is estimated by a sonar project, located on the Nushagak River below Portage Creek, approximately 32 km (20 miles) upstream from the river mouth. The Nushagak River sonar project has been used since 1980 to estimate annual escapements for all salmon species in the entire Nushagak drainage (Miller 1997). Prior to the advent of the sonar project, sockeye escapement was estimated by a counting tower project on the Nuyakuk River (1959-1988). Aerial surveys of the Nushagak-Mulchatna system were conducted annually beginning in 1966. Initial surveys provided escapement estimates for chinook and chum salmon, and surveys in the Nushagak and Mulchatna systems since 1977 were used to estimate sockeye abundance in that system. Together, the combined estimates from counting towers and aerial surveys were used by fishery managers as estimates of the Nushagak River drainage sockeye escapement.

ADF&G staff continued to survey the upper Nushagak and Mulchatna areas after the development of the sonar project to provide a comparison with sonar estimates and document spawner distribution for all species except coho salmon. Chum salmon surveys were discontinued in the Nushagak District in 1980, and surveys of the Nushagak-Mulchatna Rivers for all other species were discontinued in 1991 due to the success of the sonar project and limited funding. After terminating the Nuyakuk tower project in 1988, and terminating surveys of the Nushagak and Mulchatna systems in 1991, little information was available to assess spawning sockeye distribution in the Nushagak River.

Aerial surveys were conducted sporadically in the Tikchik Lakes system from 1954 to 1987 to assess spawner distribution of sockeye salmon. Surveys of the Tikchik Lakes were conducted infrequently since 1990 to document an apparent change in spawner distribution, evidenced by changes observed in the age composition of Nushagak River sockeye escapement, and supported by reports of low numbers of spawners in the Tikchik Lake system. These surveys have documented lower than expected numbers of spawners in the Tikchik Lakes system, based on sonar estimates in the lower Nushagak River and historical distribution patterns (Brookover et. al. 1995). However, few corresponding surveys were conducted in the Nushagak and Mulchatna drainages to completely assess distribution. With the assistance of Fisheries Research Institute personnel, the counting tower project on the Nuyakuk River was re-initiated beginning in 1995 in order to assess recent distribution and production trends in the Nushagak drainage.

Sockeye escapement is measured in the Igushik Lakes system at a counting tower located at the outlet of Amanka Lake. Spawner distribution has not been documented annually, and surveys have not been conducted on the Igushik system for sockeye salmon and other species since 1991 (Russell, et. al. 1992). Spawning escapement and distribution of sockeye salmon in the Snake Lake system was estimated annually prior to 1998 by aerial surveys, but with the closure of the Snake River section and funding shortages in recent years, these surveys have not been conducted.

Togiak District

Togiak District includes two major river drainages: (1) the Togiak River, draining Togiak, Gechiak, Pungokepuk, and Ongivinuck Lakes and Nayorurun and Kemuk Rivers (Figure 9), and (2) the Kulukak River, draining Kulukak Lake (Figure 10). Various smaller systems within the district include the Tithe Creek Ponds and the Quigmy, Matogak, Osviak, Slug, Negukthlik, and Ungalikthluk Rivers. Kulukak River and the Tithe Creek Ponds flow into Kulukak Bay, located in the eastern portion of the district. The Togiak and Quigmy Rivers flow into Togiak Bay, located in the middle of the district, and the Matogak, Osviak, and Slug Rivers flow into Hagemeister Straits and coastal waters in the western portion of the district (Figure 1).

Sockeye salmon escapement is estimated for the Togiak Lake system from counting towers operated at the outlet of Togiak Lake. Abundance and distribution of spawning populations of sockeye salmon in the Togiak River and tributaries below the counting towers, as well as other systems within the Togiak District, are estimated by aerial surveys. Abundance and distribution of chinook, chum, pink, and coho salmon spawning in Togiak District watersheds are also estimated entirely from aerial surveys.

Since 1991, the operational budget has not had sufficient funds to conduct spawning ground aerial surveys in the Togiak District. However, the USFWS and Togiak National Wildlife Refuge has provided some additional funding for aircraft charters for aerial surveys in the District to monitor salmon populations on the refuge drainages.

METHODS

All survey flights were conducted from small fixed-wing, high-wing, wheeled aircraft (Super Cub, Cessna 180, Cessna 185, or Cessna 206) or helicopter (Robinson R-22) chartered from local air charter companies and flown by experienced survey pilots. Alaska Department of Fish and Game (ADF&G) or USFWS biologists familiar with the streams and target species counted salmon. USFWS pilots and aircraft flew several of the surveys in the Togiak National Wildlife Refuge. Counts were made from low altitudes (200 to 400 feet) at air speeds of 50 to 90 mph. Polarized sunglasses and aircraft positioning were used to minimize effects of glare off the water. Surveys were scheduled to coincide as closely as possible to the historic peak of spawning for the target species, taking into account weather, water conditions, and aircraft availability. Peak of spawning was defined as that point when the greatest number of spawning salmon are occupying redds. Counts were registered on a hand tally counter or on a tape player. This information was transferred to survey data forms either sometime during the survey or upon returning to the office.

Aerial surveys account for only a portion of the known spawning populations (Evzerof, 1975; Nielson and Green, 1981; Rogers, 1984). At the time of each survey, some of the salmon have yet to reach the spawning grounds, some have already spawned and died, some are still schooled, and some are either misidentified or not seen. Methods used to interpret aerial survey counts are described below for each commercial fishing district.

Naknek/Kvichak District

Aerial surveys were flown during late summer and fall to assess escapements of sockeye, chinook and chum salmon in portions of the Naknek/Kvichak District. Salmon counts for these drainages are indices of the total number of each species present in the spawning area at the time of the survey. Two surveys were flown, August 10 and 13, to provide estimates of the Alagnak River Drainage sockeye chinook and chum escapements. Additionally, all major chinook spawning areas in the Naknek River Drainage were surveyed on August 10 and the Kvichak River on August 10. These survey counts were not expanded to provide instantaneous population estimates, although expansions have been made in some earlier years based on subjective criteria.

Counting towers were used to estimate total sockeye escapement to the Kvichak and Naknek Rivers. A late summer survey of sockeye salmon spawning distribution in the Kvichak River was completed September 20. ADF&G, Commercial Fisheries Division staff made all aerial survey counts in the district.

Egegik District

No system-wide aerial surveys were flown for sockeye salmon in 1999. An aerial survey of known chinook and chum salmon spawning areas in both the Egegik and King Salmon Rivers was flown on August 6. With funding provided by the U.S Fish and Wildlife Service (USFWS), and aerial survey were flown on September 26 to estimate coho salmon escapements. In addition, a weir was operated on Gertrude Creek by USFWS from April 9 to September 12. All aerial survey counts in the Egegik drainage reflect only the actual numbers of salmon sighted and should be considered a minimum indication of abundance.

Ugashik District

Salmon counts in the Ugashik District reflect the actual numbers of salmon sighted on the spawning grounds for 1999. Aerial surveys of known chinook and chum salmon spawning areas in the Ugashik drainage were flown on August 9. With funding provided by the Alaska Department of Fish and Game, an aerial survey was flown on October 14 to estimate coho salmon escapement. The timing of this survey was at the preferred time, unlike the previous year when logistic problems and other work assignments delayed the survey for a month. Aerial survey counts should be considered a minimum indication of total abundance.

Nushagak District

Aerial surveys were conducted to assess spawning distribution of sockeye salmon in the Wood River system in 1999. Survey methods and data analysis for the Nushagak District were similar as to those described by Nelson (1979), Bucher (1981), and Russell, Bill and Bucher (1990).

Sockeye salmon escapements for each spawning stream, beach, or, river in the Wood River System have been estimated using aerial survey results expanded by the proportion of sockeye observed at a given location in relation to the tower count. Different expansion factors were assigned to each type of spawning habitat. For a more detailed description of the analysis of Wood River survey counts, see Nelson (1973). Pink salmon are also counted on surveys primarily directed at sockeye salmon.

Togiak District

Survey and data analysis methods used in the Togiak District were similar to those described by Nelson (1979), Bucher (1981), and Russell, et. al. (1990). With few exceptions, aerial surveys of spawning sockeye, chinook, chum, and coho salmon were conducted at the peak of spawning for each species, using criteria similar to Nelson (1979) and Bucher (1981). Primarily, ADF&G staff conducted surveys, with some counts provided by USFWS Togiak National Wildlife Refuge staff.

Peak aerial survey counts for sockeye salmon in the Togiak Lake system above the counting tower have generally accounted for 47% (range: 40% - 50%) of the escapements estimated at the tower (Nelson 1967). Therefore, total escapement was estimated for sockeye salmon in systems without counting towers by multiplying peak aerial counts by 2.0 (i.e. Kulukak River, mainstem and tributaries of the Togiak River below the towers). Since 1980, total escapement for chinook salmon in the Togiak District has been calculated by aerial counts using a multiplier of 2.5 if the survey was timed properly relative to the spawning peak and visibility conditions were average. Since 1968, escapement for chum salmon has been calculated by aerial counts using a multiplier of 2.0 (Nelson 1968). Since 1978, total pink salmon escapements have also been estimated by multiplying aerial counts by 2.0. An expansion factor of 3.0 has been used for coho salmon in all areas of the Togiak District since the initiation of coho surveys in 1980. Expansion factors have been subjectively adjusted based on weather conditions, visibility, and survey timing with respect to the peak spawning activity.

RESULTS AND DISCUSSION

Naknek/Kvichak District

Aerial surveys of sockeye salmon escapement into the Alagnak River and it's tributaries were conducted on August 10 and 15. The sockeye salmon escapement index count totaled 463,600 for the system (Table 1). This is above the 1955-1998 average aerial count of 258,600 (Appendix Table 1), and was more than twice the escapement point goal of 185,000.

Aerial surveys of chinook salmon escapements into the Naknek River drainage were flown on August 18. Chinook salmon escapement counts were made in each of the four main spawning

areas: mainstem Naknek River, Big Creek, King Salmon Creek and Paul's Creek. In 1999, the mainstem Naknek River was flown late, survey total 3,320 chinook for the Naknek drainage excludes escapement to the mainstem of the Naknek River. Over the period from 1970-1999 there have been 20 years in which chinook salmon escapement indices have been obtained from all four main spawning areas (Appendix Tables 2-6). The chinook escapement index for these 20 years has ranged from a low of 2,691 in 1992 to a high of 11,730 in 1988.

Alagnak River drainage chinook salmon escapement was surveyed on August 10, estimating a total of 2,178 (Table 2). From 1970-1998, Alagnak chinook salmon counts have ranged from a low of 824 in 1973 to a high of 15210 in 1997 (Appendix Table 7). An aerial survey of chinook salmon escapement into the Kvichak River was conducted on August 10 estimating 1,200 chinook in the Kaskanak Flats area (Appendix Tables 8 and 9).

Chum salmon were counted only during the August 10 Alagnak and Kvichak River survey. Alagnak River has been the principle chum salmon producing system in the Naknek/Kvichak District (Appendix Table 10). A total of 11,800 chum salmon were observed during the survey.

Egegik District

The 1999 Egegik River sockeye escapement past the counting towers totaled 1,727,772 fish, or 57% above the mid-range objective of 1.1 million. The BEG range for Becharof Lake is 800 thousand to 1.4 million. An additional 625 sockeye salmon were observed on a postseason aerial survey in Contact Lake.

Aerial survey counts of known chinook salmon spawning areas in the Egegik drainage yielded a total count of 567 chinook salmon plus 6 chinook salmon were counted at the Egegik River counting towers (Table 3). This total was 51% below the average count of 1,178 (Appendix Table 14). Compared to the Gertrude Creek Weir count of 1,145 chinook salmon, the aerial survey count of 165 was only about 14% of the actual population. The commercial chinook harvest in the Egegik District totaled approximately 578 fish, or 79% below the 1979 to1998 average harvest of 2,726. Fishing time was reduced to three days per week between June 1 and June 16, compared to a four day per week schedule in past seasons. The lack of sockeye abundance at the beginning of the season resulted in less fishing time in June. Using gillnets with larger than 5.5-inch mesh in the commercial fishery from June 1 to July 1 was prohibited by regulation. All three of these factors probably contributed to the passage of chinook salmon through the commercial fishing district. Given the catch and escapement figures above, the Egegik chinook salmon removal rate for 1999 was probably less than 27%.

The chum salmon escapement index was 1,437 fish (Table 4). The 1999 index was well below the 1982-1998 average of 8,613 fish (Appendix Table 15). The 1999 commercial chum harvest from the Egegik District totaled approximately 75,000 fish, or 26% below the 1979 to 1998 average catch of 101,000. Escapement indices of less than 10,000 chum salmon have been recorded in each of the last ten years, but aerial surveys for chum salmon are not reliable indicators and it is believed that chum escapement indices documented over the last several years, by airplanes, have probably

greatly under estimated chum salmon escapements (Browning et.al. 1998). A comparison of the Gertrude Creek Weir count of 16,000 and an aerial survey count on August 6 shows that the aerial count revealed only about 2% of the weir count.

No pink salmon were noted during the August 6 aerial survey, but the Gertrude Weir count was 1,125. No pink salmon were reported from the commercial catch. The 1974 to 1999 pink salmon escapement indices are listed in Appendix Table 16.

The coho salmon escapement was documented with an aerial survey conducted on September 26 (Table 5). Funding for this survey was provided by the U.S. Fish and Wildlife Service in King Salmon. A total of 4,353 coho salmon were counted in the King Salmon and Egegik Rivers and in numerous tributaries of Becharof Lake. Of this total, 4,060 fish were counted upstream of the Egegik River counting towers and 293 were counted at the Gertrude Creek Weir before it was pulled on September 12. The aerial counts were focused on main coho salmon producing areas, which are listed in Table 5. Compared to the last four years, the 1999 total count above the Egegik River counting towers was 20% below average. The commercial harvest totaled approximately 11,600 fish, which was 70% below the 20-year (1979-1998) average of 39,000. The 4-day weekly schedule was reduced to two days on August 23 because of the weak run. Deliveries occurred through August 25, though officially the fishery remained open at two days per week until September 30. Historical survey counts are listed in Appendix Table 17.

Ugashik District

The 1999 sockeye salmon escapement past Ugashik River counting tower was approximately 1,647,500 fish, or 94% above the mid-range objective of 850,000. No system-wide aerial surveys were conducted due to a lack of funding, however; an additional 4,120 and 6,350 sockeye salmon were counted in the Dog Salmon and King Salmon Rivers, respectively, during a chinook and chum salmon survey (Table 6).

Chinook salmon escapement surveys of Dog Salmon, King Salmon, and Ugashik Rivers were flown on August 9 and yielded a count of 1,455 fish. Additionally, 36 chinook salmon were counted past the counting towers bringing the cumulative escapement count to about 1,491 (Table 7). The Figure Eight Creek count of 358 was the largest escapement component for the system, but only the Ugashik River count of 237 was above average. The 1999 escapement count was 68% below the 1980 to 1998 average count of 4,672 chinook salmon (Appendix Table 18). The Ugashik District's commercial catch of approximately 1,680 chinook was 54% below the 20-year average harvest of 3,620, but it was about equal to the recent 10-year average of 1,700. Overall, the 1999 Ugashik chinook run was below average.

Aerial surveys of Dog Salmon, King Salmon, and Ugashik Rivers on August 9, yielding a count of 5,048 chum salmon (Table 8). The survey was considered to be near the peak of spawning though a fair number of chum carcasses were observed. The 1999 aerial count was well below the 1980 to 1998 average of 32,000 (Appendix Table 19). The District's commercial chum salmon harvest was approximately 71,000 fish, and was average.

The Ugashik pink salmon returns have historically been very small. This year a total of 2 pink salmon were reported in the commercial catch and no pink salmon were observed on the escapement survey flown on August 9. Only 6 pinks were counted past the tower before it ceased operation on July 26 (Appendix Table 20).

An aerial survey for coho salmon was again made this year in the Ugashik drainage and results are listed in Table 9. A total of 10,210 coho salmon were observed the October 14 flight. Most of the count came from the Painter Creek in the King Salmon River drainage. For the Ugashik lakes a count of 2,170 was 14% below the 1997 and 1996 average count of 2,500. Daily commercial coho catch statistics were not only below the recent 10-year averages, but on many days they were also the worst catches per delivery in 10 years. The district was reduced to a two day per week fishing period on August 23 and stayed on that schedule for the rest of the season. The coho harvest of approximately 2,480 fish was about one tenth of the recent 10-year average. Historical coho salmon escapement data is recorded in Appendix Table 21.

Nushagak District

Spawning ground surveys for chinook salmon have been flown sporadically in the Nushagak District for the last several years due to budgetary shortfalls. The Portage Creek sonar counting project produced an apportioned estimate of 62,331 chinook salmon in the Nushagak River for 1999. Water levels were relatively normal. Due to counting problems in 1997 associated with unusually high water temperatures and low flows, additional mid-river sampling was conducted again this season to investigate possible chinook migration routes outside the sonified portion of the water column. Aerial surveys were flown July 27 in the Lower Nushagak and July 28 in the Upper Nushagak and Mulchatna River systems. Survey conditions were fair with average timing relative to the peak of spawning. In addition, survey results indicated spawning populations commensurate with the sonar estimate.

Spawning escapement of sockeye salmon in the Wood River system was estimated to be 1.51 million fish - 25% over the upper end of the 700 thousand to 1.2 million escapement goal range. Two-ocean sockeye comprised approximately 71% of the Wood River escapement while three-ocean sockeye contributed the other 29% of the escapement; hence Wood River was managed for the 1.2 million end of the escapement goal range. Poor sockeye run strength in the Nushagak River necessitated conservative management of the Nushagak District commercial fishery in 1999. With the new OEG minimum escapement goal for the Nushagak River of 235,000 sockeye salmon when the Wood to Nushagak sockeye ratio was projected to exceed 3:1, management staff had to implement new strategies for regulating escapement into the Wood and Nushagak Rivers. Balancing a strong sockeye return to the Wood River with relatively weak return to the Nushagak River was the management strategy, and this combined with a processing capacity problem led to the large escapement in the Wood River system in 1999.

Only one aerial survey was flown on August 13 on the Wood River Lakes drainage. This survey was conducted on most of the creeks; aircraft availability and weather precluded finishing the

remaining surveys on the beaches and rivers of the Wood River Lakes system. No distribution data is available for 1999 as a result of this incomplete survey series.

An estimate of pink salmon spawning escapements for even years from aerial surveys in the Nushagak District is given in Appendix Table 23.

Togiak District

Peak aerial counts and total population estimates were derived from aerial surveys for sockeye salmon in major river systems of the Togiak District in 1999. (Table11). The expanded aerial survey estimate of 40,200 sockeye salmon for the Togiak River and its tributaries below the counting tower was 52% above the 1979-1998 average of 26,450 fish (Appendix Table 24). Escapement past the counting tower was 155,900 sockeye, 4% over the escapement goal of 150,000. The spawning escapement of sockeye salmon in Kulukak Section, including Kulukak River, Kulukak Lake, and Tithe Creek Ponds, was estimated at 12,300 fish, only 39% of the 1979-1998 average of 31,800. Peak aerial sockeye salmon live counts into the mainstem portion of the Togiak River and Kemuk River were below the 1979-1998 average (Appendix Tables 25 and 26), while counts for the Gechiak, Nayorurun and Ongivinuck tributaries to the Togiak River were above average. Live Sockeye counts for the Pungokepuk River were average. Total sockeye salmon escapement for Togiak District was 231,200. Due to weather, surveys were conducted after the peak of spawning on the Kulukak, Negukthlik and Ungalikthluk Rivers, while the majority of systems were surveyed at peak spawning levels in the Togiak District drainages. A standard multiplier was applied everywhere except for the Togiak River tributaries, which was 1.5 due to low and very clear water conditions.

Aerial surveys for peak live counts and expanded escapement estimates for chinook salmon were conducted in all the major drainages within the Togiak District for 1999 (Table 12). Conditions and timing were good to fair for most of the chinook salmon systems surveyed during the 1999 chinook surveys, however, due to turbid water and light conditions in the Togiak mainstem, Osviak and Negukthlik Rivers a factor of 3.0 was applied to compensate for poor visibility. In the tributaries to the Togiak River and the smaller systems in the western portion of the district where conditions were average, the standard factor of 2.5 was used. The expanded escapement estimate for Togiak District was 12,260 chinook salmon. The 1999 district-wide chinook escapement was 17% below the 5-year average of 14,810 fish (ADF&G, 1999). The aerial peak live count for the Togiak River and tributaries was 13% below the 1979-1998 average, and aerial counts for all chinook systems in the Togiak District combined were 24% below the 20-year average (Appendix Tables 27 and 28). The escapement goal of 10,000 chinook salmon into the Togiak River was virtually achieved with an expanded spawning estimate of 9,520 fish. Chinook peak aerial counts for Quigmy, Kulukak, Osviak and Negukathlik Rivers were all below average, while Matogak, Slug and Ungalikthluk Rivers were at or above average. The Kulukak River escapement estimate (240 chinook) was poor and comprised only 27% of the 1979-1998 Kulukak River average.

Chum salmon counts were conducted coincidentally with the chinook salmon surveys. Chum salmon escapement was poor in the entire Togiak District except for the Slug and Ungalikthluk Rivers, and was estimated to be 116,200 (Table 13, Appendix Tables 29 and 30). This 1999 estimate is 43% below the 1979-1998 average (205,340 chum) reported by ADF&G (1999). Peak live counts for the Slug River were 20% above average, while the Ungalikthluk River was 202% above average. Survey timing was generally good for chum salmon spawning activity, except significant numbers of chum salmon carcasses were observed in the Slug River.

Pink salmon aerial escapement surveys are flown in even years; counts (for even years only) may be perused in Appendix Table 23.

Aerial surveys yielding peak live counts and expanded escapement estimates for coho salmon were successfully completed for all major systems in Togiak District for 1999. Total coho escapement for Togiak River and tributaries was estimated to be 3,860 fish (Table 14). This is 91% below the 1980-1998 average of 40,960 fish. District-wide coho live counts were 87% below the average for the same period (Appendix Tables 31 and 32). Coho salmon appeared to be mostly on spawning beds, some schools were observed and few carcasses were visible, indicating that the survey was probably at or near the peak of spawning activity.

Surveys for Togiak River, Togiak River tributaries, streams west of Togiak River, Negukthlik and Ungalikthluk Rivers were flown in conjunction with USFWS.

LITERATURE CITED

ADF&G (Alaska Department of Fish and Game). *In press.* Annual Management Report, 1999, Bristol Bay Area. Alaska Department of Fish and Game, Commercial Fisheries Division. Anchorage.

Brookover T.E., J.B. Browning, J.R. Regnart, R.B.Russell, and K.A. Weiland. 1996. Salmon spawning ground surveys in the Bristol Bay area, 1995. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 2A96-31, Anchorage.

Browning J.B., J.R. Regnart, and K.A. Weiland. 1998. Salmon spawning ground surveys in the Bristol Bay area, 1997. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 2A98-34, Anchorage.

Bucher, W.A. 1981. Spawning ground surveys in the Nushagak and Togiak Districts of Bristol Bay, 1980. Alaska Department of Fish and Game, Division of Commercial Fisheries, Bristol Bay Data Report 81, Anchorage.

Evzerov, A.V. 1975. An evaluation of the errors occurring in salmon census by aerial survey. In Canadian Translation Fisheries and Aquatic Sciences. No. 4714, 1981. [Transl. from Russian] (Otsenka pogreshnogtei aerovizual`nogo metoda ucheta Lososei), p. 82-84. From Lososevye Dal`Nego Vostoka (CVI:1975).

Miller, J.X. 1997. Sonar enumeration of pacific salmon escapement into the Nushagak River, 1997. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report No. 2A96-08, Anchorage.

Nielson, J.D. and G.H. Green, 1981. Enumeration of spawning salmon from spawner residence time and aerial counts. Transactions of the American Fisheries Society 110:554-556.

Nelson, M.L. 1967. Red salmon spawning ground surveys in the Nushagak and Togiak Districts, Bristol Bay, 1966. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 96.

Nelson, M.L. 1968. Spawning ground surveys in the Nushagak and Togiak Districts, Bristol Bay, 1968. Alaska Department of Fish and Game, Division of Commercial Fisheries, Bristol Bay Data Report 5.

Nelson, M.L. 1973. Spawning ground surveys in the Nushagak and Togiak Districts of Bristol Bay, 1973. Alaska Department of Fish and Game, Division of Commercial Fisheries, Bristol Bay Data Report 46.

LITERATURE CITED (Continued)

Nelson, M.L. 1979. Spawning ground surveys in the Nushagak and Togiak Districts of Bristol Bay, 1977-1979. Alaska Department of Fish and Game, Division of Commercial Fisheries, Bristol Bay Data Report 73, Anchorage.

Regnart, J.R. 1996. Kvichak River sockeye salmon spawning ground surveys, 1955-1996. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report No. 2A95-48, Anchorage.

Rogers, D.E. 1984. Aerial survey estimates of Bristol Bay sockeye salmon escapements. Proceedings of the Workshop on Stream Indexing for Salmon Escapement Estimation. Canadian Technical Report of Fisheries and Aquatic Sciences. 1326:197-208.

Russell, R.B., D.L. Bill, and W.A. Bucher. 1990. Salmon spawning ground surveys in the Bristol Bay area, 1989. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 2K89-15, Anchorage.

Russell, R.B., J.R. Regnart, and T.E. Brookover. 1992. Salmon spawning ground surveys in the Bristol Bay area, 1991. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 2A92-01, Anchorage.

Table 1. Aerial survey counts of sockeye salmon, Alagnak River system, 1999[a]

Location	Number of Fish	Percent of Total
Nonvianuk River	100	0.0
Nonvianuk Lake	15,000	3.2
Kulik River	32,000	6.9
Kulik Lake	2,000	0.4
Alagnak River	0	0.0
Kukaklek Lake	0	0.0
Nanuktuk Creek	92,000	19.8
Battle River	49,000	10.6
Battle Lake	11,500	2.5
Spectacle Creek	152,000	32.8
Funnel Creek	110,000	23.7
Total	463,600	100.0

[a] Aerial surveys were conducted with fixed-wing aircraft.

Table 2. Aerial survey counts of chinook, chum, pink, and coho salmon, Naknek-Kvichak District, 1999.[a]

Location	Survey Date	Number of Salmon			
		Chinook	Chum	Pink	Coho
Kvichak River	10-Aug	1,200	800 [b]		
Alagnak River	10-Aug	2,178	11,800 [b]		
Naknek River :					
Paul's Creek	2-Aug	223	0 [b]		
King Salmon Creek	2-Aug	847	350 [b]		
Big Creek	2-Aug	2,250	NC [b]		
Mainstem Naknek River	8-Sep	NC [c]			
Total		6,698	12,950		

[a] Aerial surveys were conducted with fixed-wing aircraft.

[b] Incidental observation.

[c] No count (NC) was possible due to high water and latenes of survey.

Table 3. Aerial survey peak counts of chinook salmon escapement, Egegik District, 1999.

Location	Survey Date	Number of Chinook Salmon Counted
Egegik River	Aug. 6 [a]	6
Shosky Creek	Aug. 6	75
Whale Mountain Creek	Aug. 6	10
Mossy Creek	Aug. 6	51
Mink Creek	Aug. 6	0
Gertrude Creek	Aug. 6	165
Kaye's Creek	Aug. 6	6
Takayoto Creek	Aug. 6	115
Angle Creek	Aug. 6 [b]	
Contact Creek	Aug. 6	145
Mainstem King Salmon River	Aug. 6 [b]	
Total		573

[a] Tower count.
[b] No counts due to turbid water conditions.

Table 4. Aerial survey peak counts of chum salmon escapement, Egegik District, 1999.

Location	Survey Date	Number of Chum Salmon Counted
Egegik River	Aug.6 [a]	6
Shosky Creek	Aug.6	0
Whale Mountain Creek	Aug.6	1,040
Mossy Creek	Aug.6	4
Mink Creek	Aug.6	0
Gertrude Creek	Aug.6	243
Kaye's Creek	Aug.6	0
Takayoto Creek	Aug.6	4
Angle Creek	Aug.6 [b]	
Contact Creek	Aug.6	140
Mainstem King Salmon River	Aug.6 [b]	
Total		1,437

[a] Tower count.
[b] No counts due to turbid water conditions.

Table 5. Aerial survey counts of coho salmon escapement, Egegik District, 1999.

Location	Survey Date	Number of Coho Salmon Counted	Comments
Egegik River Drainage[a]			
Egegik River Rapids	September 26	0	30 dead unspent bright fish seen on the bottom of the river.
Stream 115.8 (Featherly Creek)	September 26	280	all schooled up, no fish seen on redds.
Stream 107.6 (Burl's Creek)	September 26	400	visibilty was difficult at times due to shadows.
Stream 90.3 (Salmon Creek)	September 26	810	
Stream 89.8	September 26	510	
Stream 87.0 (Bear Creek)	September 26	320	
Stream 73.5 (Becharof Creek)	September 26	830	
Stream 48.1 (Kejulik River)	September 26	910	Includes Margaret & Albert Creeks
Sub-total		4,060	
King Salmon River Drainage			
Gertrude Creek	September 12	293	U.S. Fish and Wildlife Weir Count
Sub-total		293	
District Total		4,353	

[a] Streams tributary to Becharof Lake are designated by the number of miles between their mouth and the outlet of Becharof Lake (Egegik River) as one travels around the lake in a clockwise fashion from the Becharof lake outlet. This is the same system of designation used for years by previous investigators. Due to logistic problems only one survey was flow this season.

Table 6. Aerial survey peak counts of sockeye salmon escapement, King Salmon and Dog Salmon River, Ugashik District, 1999.

Location	Survey Date	Number of Sockeye Salmon Counted
King Salmon River System:		
Needle Lake	Aug. 9	350
Volcano Creek	Aug. 9	[a]
Painter Creek	Aug. 9	6,000
Indecision Creek	Aug. 9	[a]
Sub-total		6,350
Dog Salmon River System:		
Figure-Eight Creek	Aug. 9	4,000
Goblet Creek	Aug. 9	0
Oldham Creek	Aug. 9	120
Wandering Creek	Aug. 9	0
Mainstem Dog Salmon River	Aug. 9	[a]
Sub-total		4,120
Total		10,470

[a] No fish were observed due to turbid water conditions.

Table 7. Peak survey counts of chinook salmon escapement, Ugashik District, 1999.

Location	Survey Date	Number of Chinook Salmon Counted
King Salmon River System		
Old Creek	Aug. 9	213
Pumice Creek	Aug. 9	340
Painter Creek	Aug. 9	166
Mainstem King Salmon River	Aug. 9	[a]
Indecision Creek	Aug. 9	[a]
Volcano Creek	Aug. 9	[a]
Sub-total		719
Dog Salmon River System		
Figure-Eight Creek	Aug. 9	358
Goblet Creek	Aug. 9	87
Oldham Creek	Aug. 9	90
Wandering Creek	Aug. 9	0
Mainstem Dog Salmon River	Aug. 9	[a]
Sub-total		535
Ugashik River System		
Mainstem Ugashik River	Aug. 9	36 [b]
Grassy Creek	Aug. 9	201
Sub-total		237
Total		1,491

[a] No fish were observed due to turbid water conditions.
[b] Tower count only.

Table 8. Peak survey counts of chum salmon escapement, Ugashik District, 1999.

Location	Survey Date	Number of Chum Salmon Counted
King Salmon River System		
Old Creek	Aug. 9	2,020 [a]
Pumice Creek	Aug. 9	1,660 [a]
Painter Creek	Aug. 9	650
Mainstem King Salmon River	Aug. 9	[b]
Needle Lake	Aug. 9	50
Indecision Creek	Aug. 9	[b]
Volcano Creek	Aug. 9	
Sub-total		4,380
Dog Salmon River System		
Figure-Eight Creek	Aug. 9	220
Goblet Creek	Aug. 9	20
Oldham Creek	Aug. 9	20
Wandering Creek	Aug. 9	40
Mainstem Dog Salmon River	Aug. 9	100
Sub-total		400
Ugashik River System		
Mainstem Ugashik River	Aug. 9	18 [c]
Grassy Creek	Aug. 9	260
Sub-total		278
Total		5,058

[a] Includes carcasses.
[b] Water was too turbid to see fish.
[c] Includes tower and below tower counts.

Table 9. Aerial survey counts of coho salmon escapement, Ugashik District, 1999. [a]

Location	Survey Date	Number of Coho Salmon Counted	Comments
	Ugashik Drainage		
Upper Ugashik Lake			
Crooked Creek	October 14	670	few fish on redds
Deer Creek	October 14	470	few fish on redds
Lower Ugashik Lake			
Black Creek to Cabin	October 14	880	
Black Creek to Elizabeth Lake	October 14	0	
Ugashik Outlet	October 14	150	
King Salmon River Tributaries			
Pumice Creek	October 14	1,910	all fish were in schools, none were seen paired-up.
Old Creek	October 14	970	
Painter Creek	October 14	4,760	includes 50 carcasses
Dog Salmon River Tributaries			
Figure Eight Creek	October 14	400	
District Total		10,210	

[a] Only one survey was flown.

Table 10. Peak aerial live counts and total escapement estimates of sockeye salmon in the Wood River system, 1999.

Area	Date	Aerial Count [a]	Population Estimate	Distribution %
Wood River				
Lake Aleknagik		29,470		
Eagle Creek[b]	8/9/99	1,220		
Hansen Creek				
Happy Creek[b]	8/5/99	5,930		
Bear Creek[b]	8/6/99	3,540		
Yako Creek[b]	8/2/98	4,640		
Whitefish Creek[b]	8/14/99	1,470		
Ice Creek[b]	8/7/99	8,880		
Mission Creek[b]	8/15/99	3,130		
Sunshine Creek	8/13/99	630		
Youth Creek	8/13/99	30		
Northshore Beaches				
Southshore Beaches				
Yako Beaches				
Agulowok River & lower River Bay				
Lake Nerka		17,610		
Fenno Creek[b]	8/13/99	1,130		
Pike Creek	8/13/99	200		
Stovall Creek	8/13/98	1,650		
Bear Creek[c]	8/13/99	100		
Teal Creek	8/13/99	1,000		
Pick Creek[b]	8/14/99	4,550		
Elva Creek[b]	8/26/99	50		
Kema Creek	8/13/99	6,400		
Hidden Lake Creek[b]	8/19/99	1,840		
Lynx Creek[b]	8/23/99	690		
Upper River Bay Beaches, NW				
Upper River Bay Beaches, SE				
Allan Cr. - Ross Cr. Beaches				
N6 - River Bay Beach				
Pick Creek Beach				
Elva Creek Beach				
Amakuk Arm Beaches				

(Continued)

Table 10. (Continued)

Area	Date	Aerial Count [a]	Population Estimate	Distribution %
Amakuk Arm - Ott's Bay Beach				
Ott's Bay Beach				
Anvil Bay Beaches				
Anvil Bay - Elbow Pt. Beach				
Elbow Pt. - Lynx Cr. Beach				
Lynx Cr. - Teal Cr. Beach				
Kema Lake Beaches				
Hidden Lake Beaches				
Lynx Lake Beaches				
Little Togiak River[b]	8/21/99	20		
Little Togiak Lake				
Northshore Beaches				
Southshore Beaches				
D Slough Beaches				
Agulukpak River				
Lake Beverley		12,980		
Tsun Creek	8/13/98	280		
Moose Creek	8/13/99	7,250		
Hope Creek	8/13/99	5,450		
Hardluck Bay Beaches				
Sam's Beach				
Golden Horn Beaches				
Silver Horn Beaches				
B12 & B9 Beaches				
Hope Lake Beach				
Peace River				
Lake Mikchalk				
Narrows				
Northshore Beaches				
Southshore Beaches				

(Continued)

Table 10. (Continued)

Area	Date	Aerial Count [a]	Population Estimate	Distribution %
Wind River				
Lake Kulik		1,230		
K1 & K2 Creeks	8/13/99	1,230		
K5 Creek - Grant River Beaches				
Grant River - K2 Creek Beaches				
Southshore Beaches				
Grant River	8/13/99	6,100		
Total		67,410		

[a] All counts rounded to the nearest 10 fish.

[b] Ground survey counts conducted by FRI, University of Washington..

[c] Access blocked by beaver dams.

Table 11. Peak aerial counts of live sockeye salmon and total escapement estimates, Togiak District, 1999.

River		Aerial Counts		Total Escapement Estimates	
		Date	Number	Factor [a]	Number
Togiak Section					
Togiak River mainstem					
	A	13-Aug	225	2.0	450
	B	13-Aug	150	2.0	300
	C	13-Aug	50	2.0	100
	D	13-Aug	350	2.0	700
	E	13-Aug	650	2.0	1,300
	F	13-Aug	3,975	2.0	7,950
	Subtotal		5,400		10,800
Gechiak River		13-Aug	11,275	1.5	16,913
Pungokepuk River		13-Aug	1,475	1.5	2,213
Nayorurun River		13-Aug	100	1.5	150
Kemuk River		13-Aug	75	1.5	113
Ongivinuk River		13-Aug	6,700	1.5	10,050
	Subtotal		19,625		29,438
	Togiak River Drainage Total		25,025		40,238
Kulukak Section					
Kulukak River		24-Aug	2,950	2.0	5,900
Kanik R./Tithe Creek Ponds		24-Aug	3,200	2.0	6,400
	Subtotal		6,150		12,300
Matogak, Osviak, and Cape Pierce Sections					
Matogak River[b]		16-Aug	660	2.0	1,320
Osviak River[b]		13-Aug	2,210	2.0	4,420
Slug River[b]		13-Aug	5,970	2.0	11,940
	Subtotal		8,840		17,680
Other					
Quigmy River[b]		16-Aug	290	2.0	580
Negukthlik River		25-Aug	1,625	2.0	3,250
Ungalikthluk River		25-Aug	625	2.0	1,250
	Subtotal		2,540		5,080
Total			42,555		75,298

a Derived by expanding peak live count to reflect fish not counted due to variables such as schooled and dead fish, late or poor survey conditions, bad weather, etc..

b USFWS estimate.

Table 12. Peak aerial counts of live chinook salmon and total escapement estimates, Togiak District, 1999.

River		Aerial Counts		Total Escapement Estimates	
		Date	Number	Factor [a]	Number
Togiak Section					
Togiak River mainstem					
	A	27-Jul	150	3.0	450
	B	27-Jul	210	3.0	630
	C	27-Jul	540	3.0	1,620
	D	27-Jul	510	3.0	1,530
	E	27-Jul	225	3.0	675
	F	27-Jul	480	3.0	1,440
	Subtotal		2,115		6,345
Gechiak River		27-Jul	365	2.5	913
Pungokepuk River		27-Jul	90	2.5	225
Nayorurun River		27-Jul	240	2.5	600
Kemuk River		27-Jul	305	2.5	763
Ongivinuk River		27-Jul	270	2.5	675
	Subtotal		1,270		3,175
	Togiak River Drainage Total		3,385		9,520
Kulukak Section					
Kulukak River		27-Jul	240	2.5	600
Matogak, Osviak, and Cape Pierce Sections					
Matogak River[b]		29-Jul	105	2.5	263
Osviak River		29-Jul	40	3.0	120
Slug River		29-Jul	150	2.5	375
	Subtotal		295		758
Other					
Quigmy River[b]		29-Jul	10	2.5	25
Negukthlik River		28-Jul	345	3.0	1,035
Ungalikthluk River		28-Jul	130	2.5	325
	Subtotal		485		1,385
Total			4,405		12,263

a Derived by expanding peak live count to reflect fish not counted due to variables such as schooled and dead fish, late or poor survey conditions, bad weather, etc..

b USFWS estimate.

Table 13. Peak aerial counts of live chum salmon and total escapement estimates, Togiak District, 1999.

River		Aerial Counts		Total Escapement Estimate	
		Date	Number	Factor [a]	Estimate
Togiak Section					
Togiak River mainstem					
	A	27-Jul	3,975	2.5	9,938
	B	27-Jul	1,950	2.5	4,875
	C	27-Jul	2,375	2.5	5,938
	D	27-Jul	1,300	2.5	3,250
	E	27-Jul	1,725	2.5	4,313
	F	27-Jul	2,200	2.5	5,500
	Subtotal		13,525		33,813
Gechiak River		27-Jul	1,840	2.0	3,680
Pungokepuk River		27-Jul	440	2.0	880
Nayorurun River		27-Jul	4,230	2.0	8,460
Kemuk River		27-Jul	480	2.0	960
Ongivinuk River		27-Jul	2,540	2.0	5,080
	Subtotal		9,530		19,060
	Togiak River Drainage Total		23,055		52,873
Kulukak Section					
Kulukak River		27-Jul	3,430	2.0	6,860
Matogak, Osviak, and Cape Pierce Sections					
Matogak River [b]		29-Jul	5,700	2.0	11,400
Osviak River		29-Jul	3,650	2.5	9,125
Slug River		29-Jul	4,750	2.0	9,500
	Subtotal		14,100		30,025
Other					
Quigmy River [b]		29-Jul	1,340	2.0	2,680
Negukthlik River		28-Jul	410	2.5	1,025
Ungalikthluk River		28-Jul	11,360	2.0	22,720
	Subtotal		13,110		26,425
Total			53,695		116,183

a Derived by expanding peak live count to reflect fish not counted due to variables such as schooled and dead fish, late or poor survey conditions, bad weather, etc..

b U.S. Fish and Wildlife Service estimate.

Table 14. Peak aerial counts of live coho salmon and total escapement estimates, Togiak District, 1999.

River		Aerial Counts		Total Escapement Estimate	
		Date	Number	Factor [a]	Estimate
Togiak Section					
Togiak River mainstem					
	A	08-Oct	250	3.0	750
	B	08-Oct	75	3.0	225
	C	08-Oct	50	3.0	150
	D	08-Oct	25	3.0	75
	E	08-Oct	100	3.0	300
	F	08-Oct	175	3.0	525
	Subtotal		675		2,025
Gechiak River		07-Oct	275	3.0	825
Pungokepuk River		07-Oct	35	3.0	105
Nayorurun River		07-Oct	100	3.0	300
Kemuk River		07-Oct	25	3.0	75
Ongivinuk River		07-Oct	175	3.0	525
	Subtotal		610		1,830
	Togiak River Drainage Total		1,285		3,855
Kulukak Section					
Kulukak River		08-Oct	375	3.0	1,125
Matogak, Osviak, and Cape Pierce Sections					
Matogak River [b]		07-Oct	220	3.0	660
Osviak River [b]		07-Oct	213	3.0	639
Slug River [b]		07-Oct	117	3.0	351
	Subtotal		550		1,650
Other					
Quigmy River [b]		07-Oct	169	2.0	338
Negukthlik River		08-Oct	95	3.0	285
Ungalikthluk River		08-Oct	450	3.0	1,350
	Subtotal		714		1,973
Total			2,924		8,603

a Derived by expanding peak live count to reflect fish not counted due to variables such as schooled and dead fish, late or poor survey conditions, bad weather, etc..

b U.S. Fish and Wildlife Service estimate.

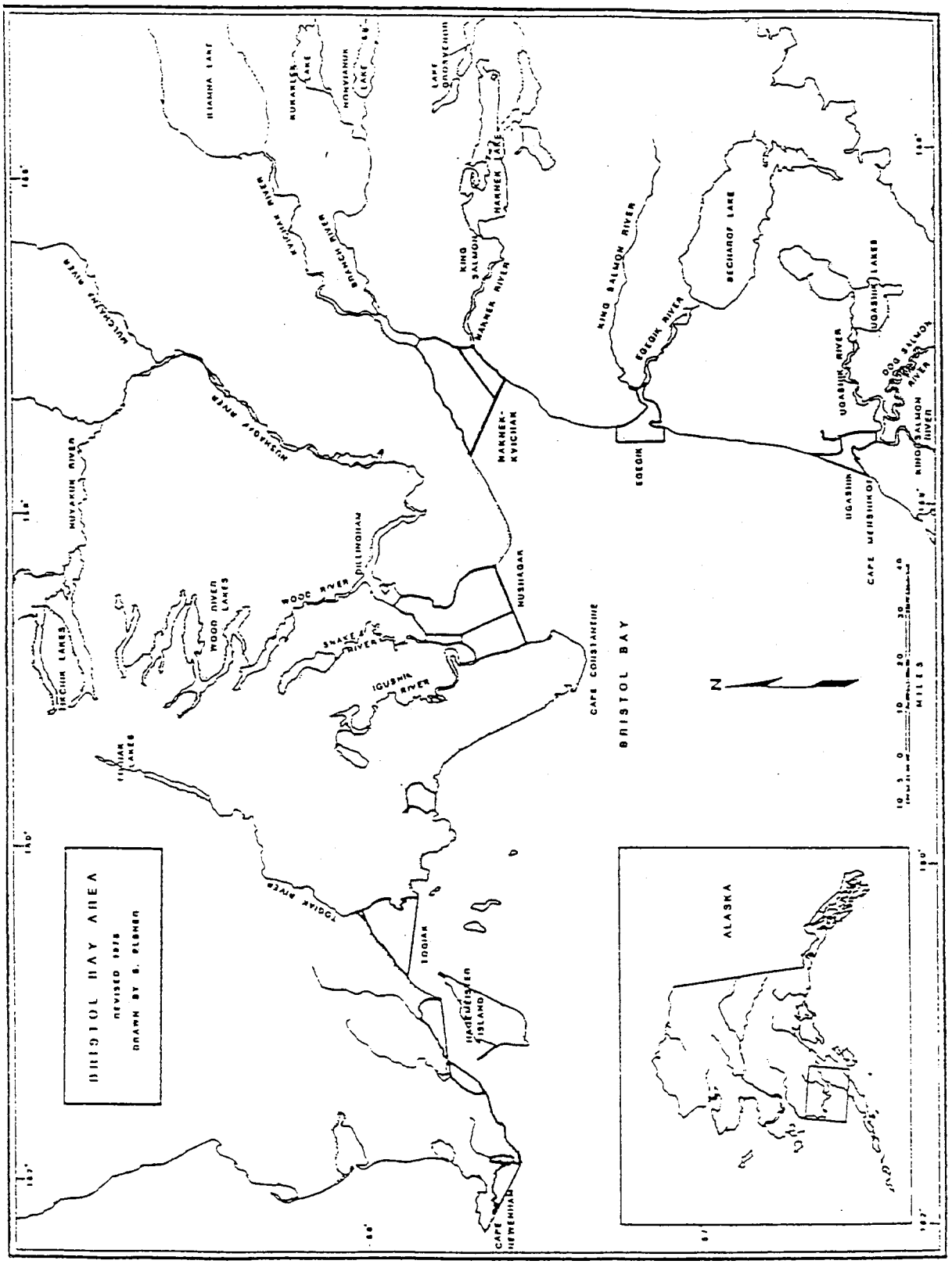

Figure 1. Bristol Bay management area, Alaska.

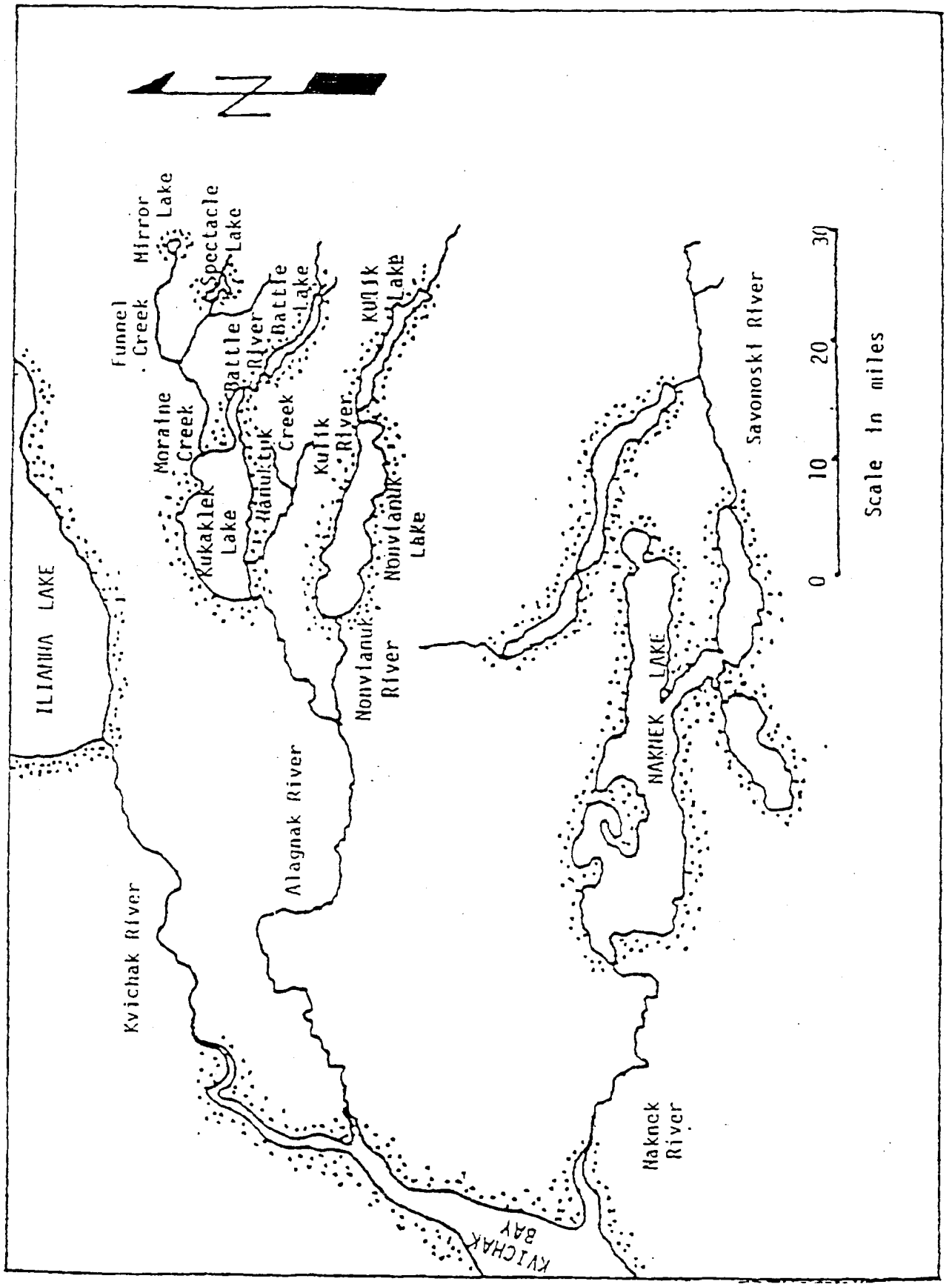

Figure 2. Alagnak River drainage, Bristol Bay, Alaska.

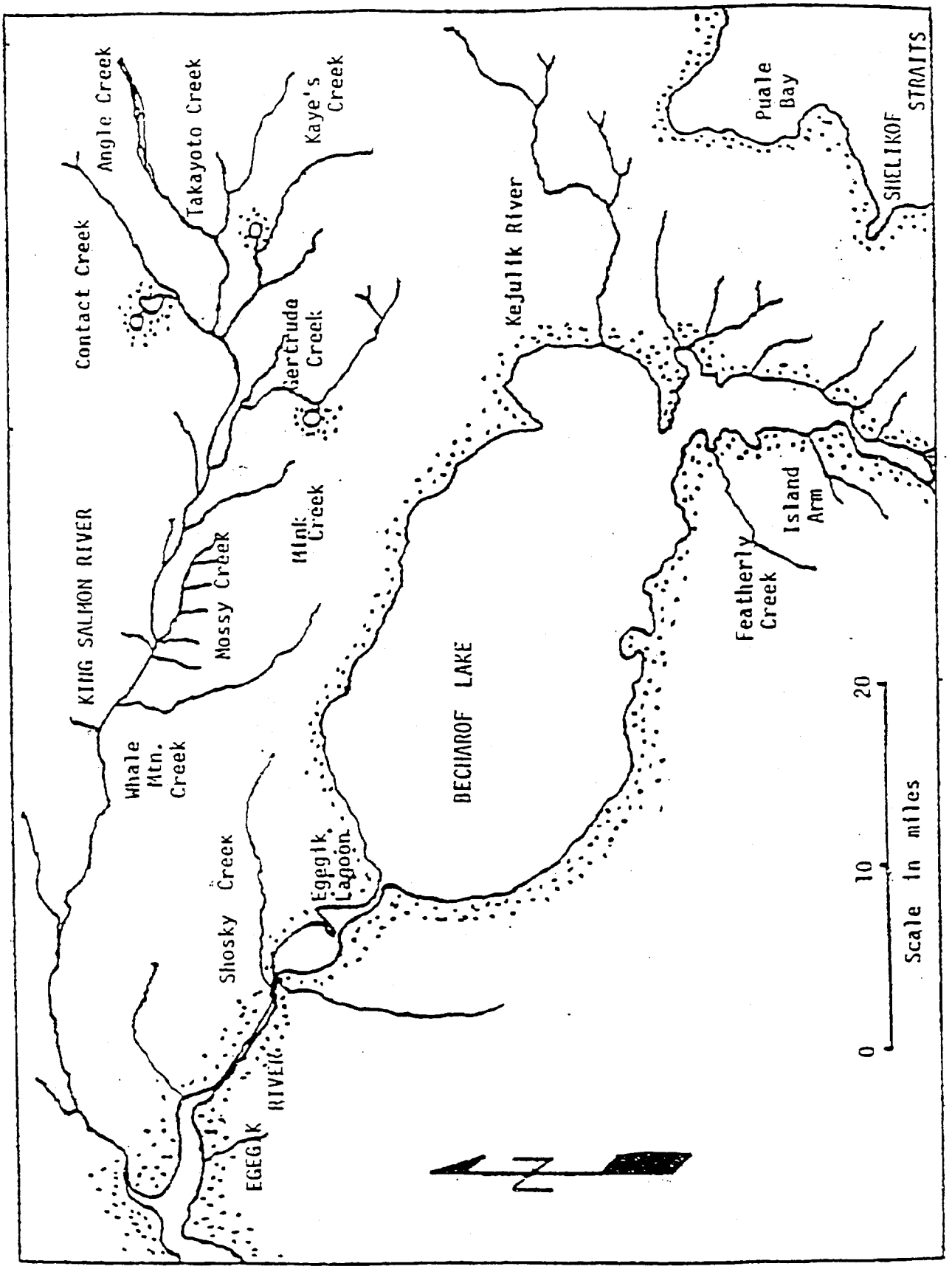

Figure 3. Egegik River drainage, Bristol Bay, Alaska.

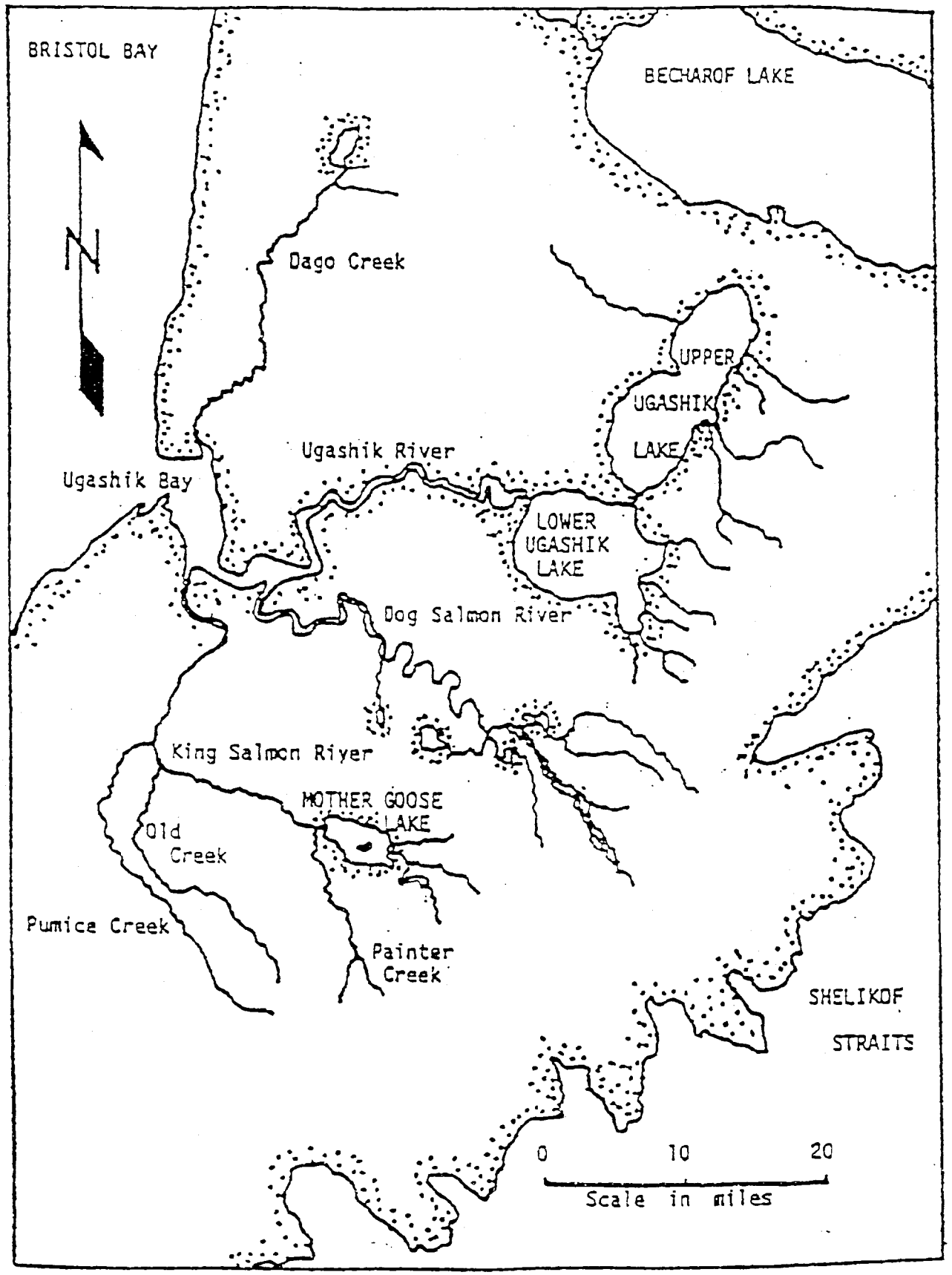

Figure 4. Ugashik River drainage, Bristol Bay, Alaska.

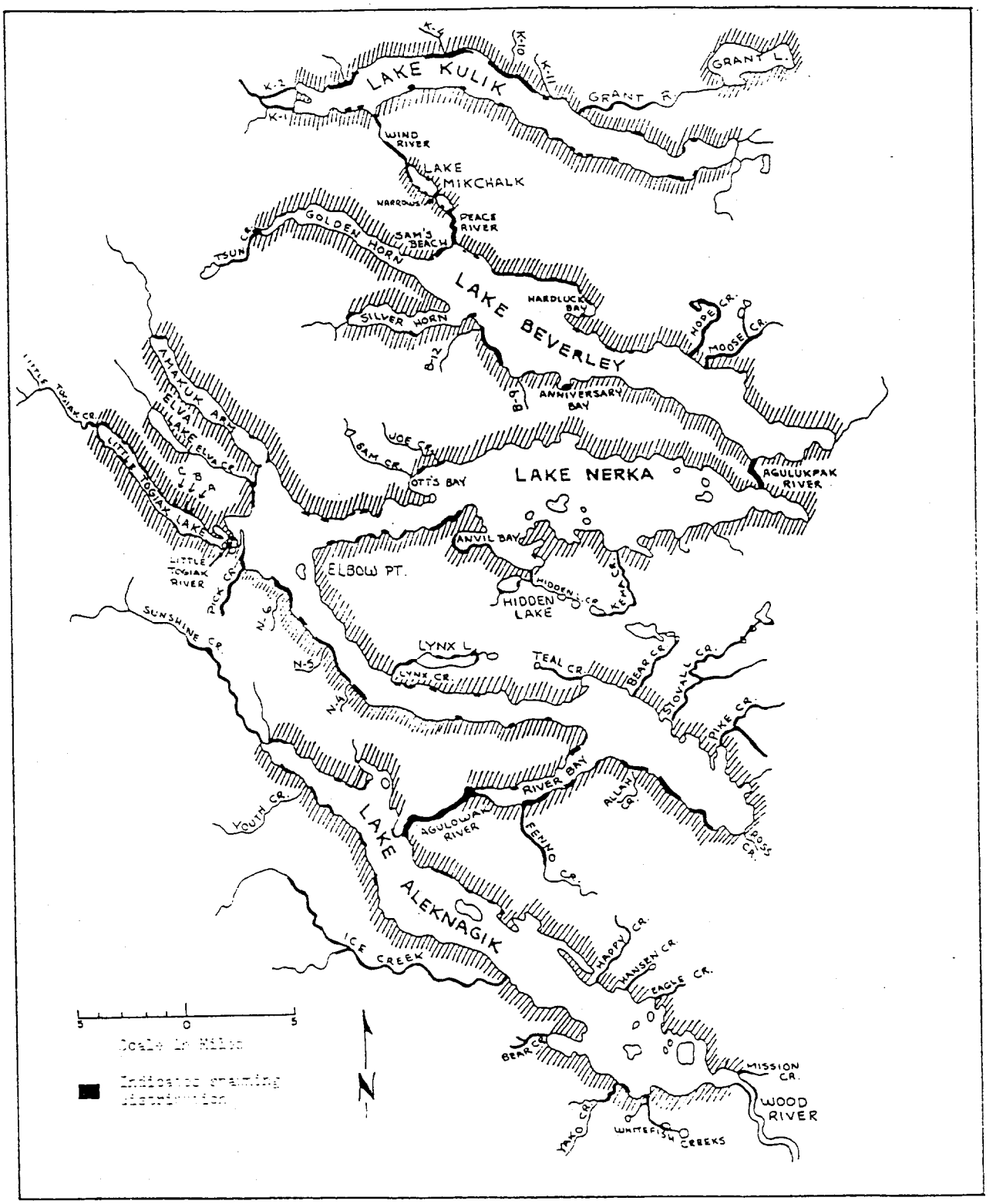

Figure 5. Wood River Lakes system, Bristol Bay, Alaska.

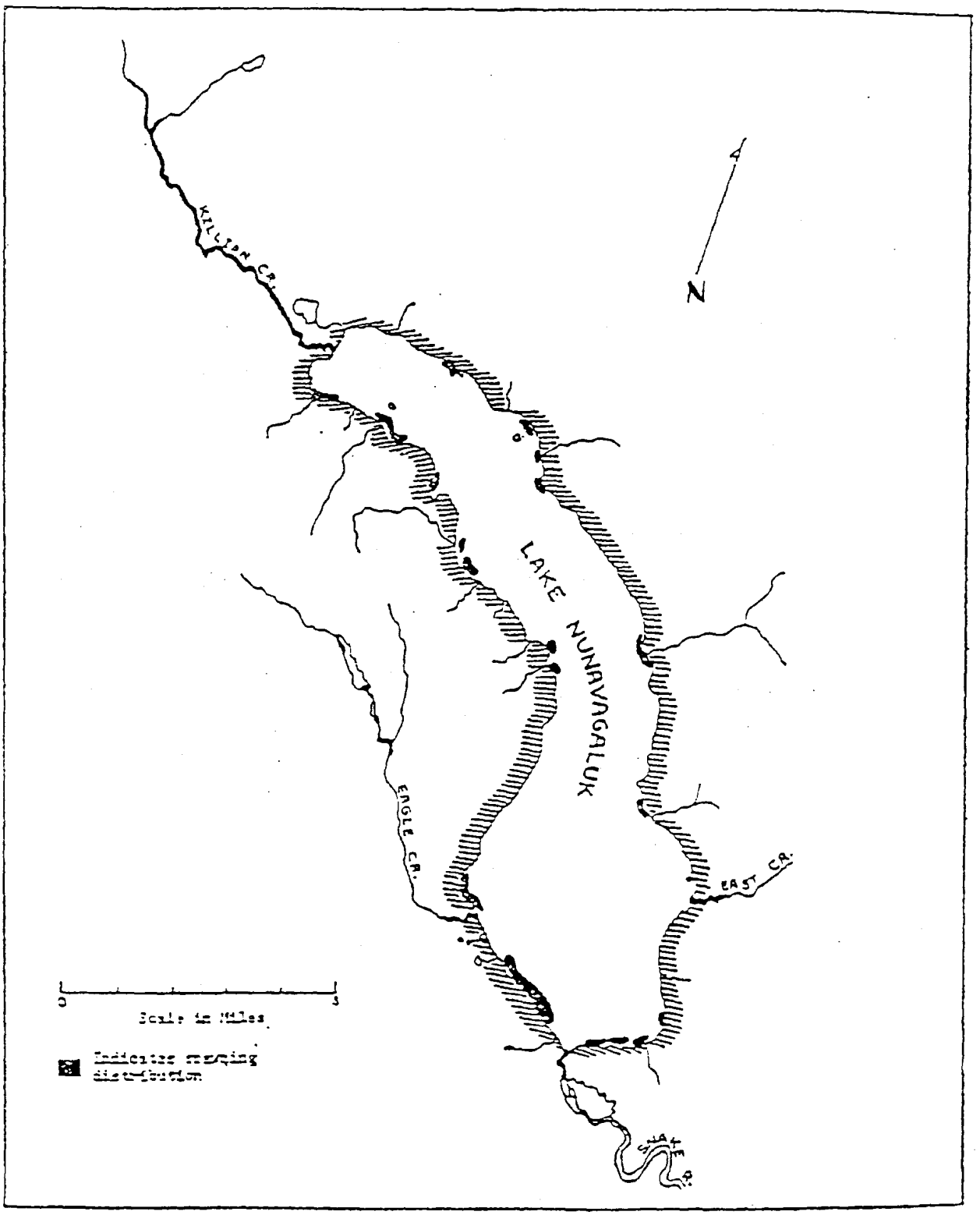

Figure 6. Lake Nunavaugaluk system, Bristol Bay, Alaska.

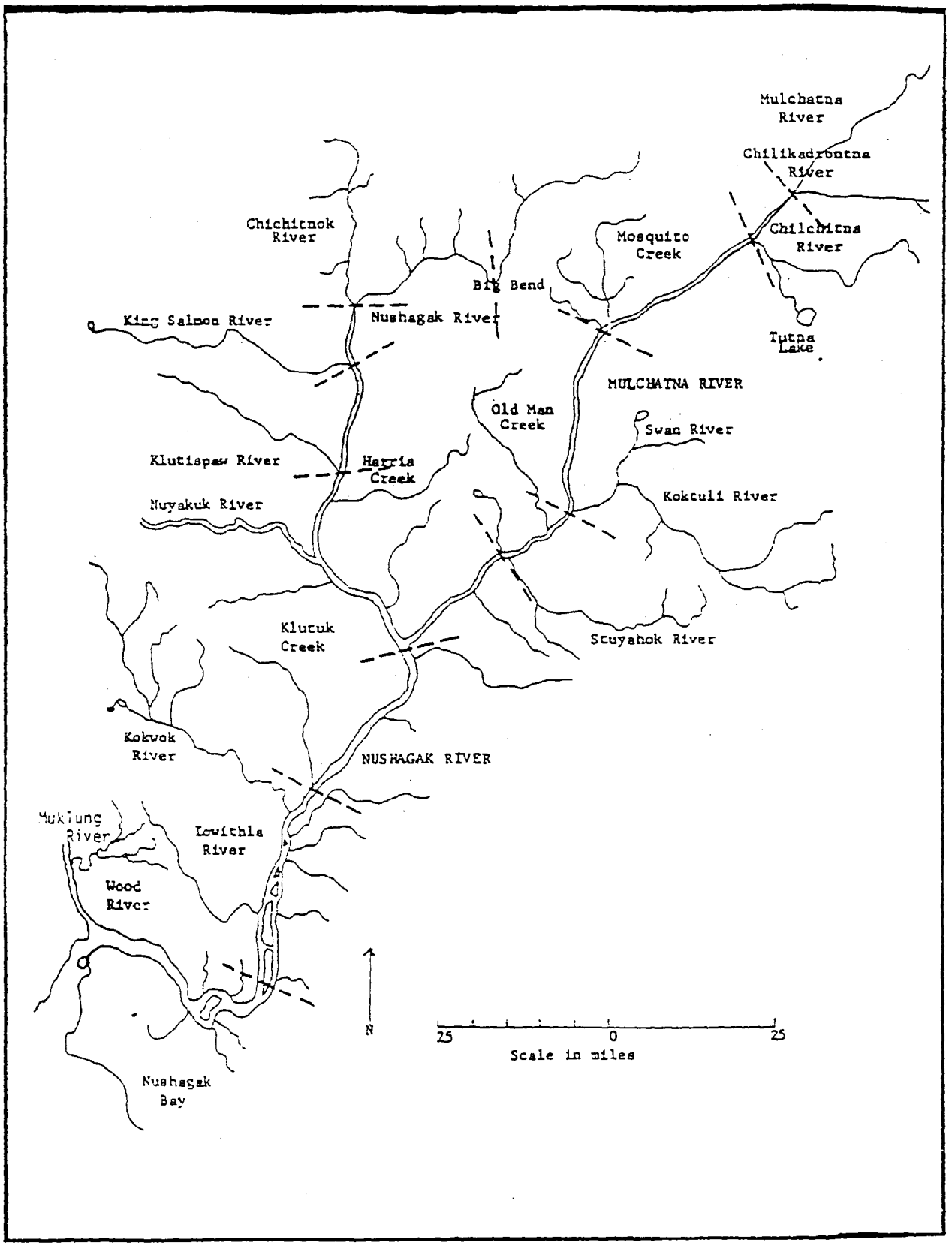

Figure 7. Nushagak-Mulchatna River system, Bristol Bay, Alaska.

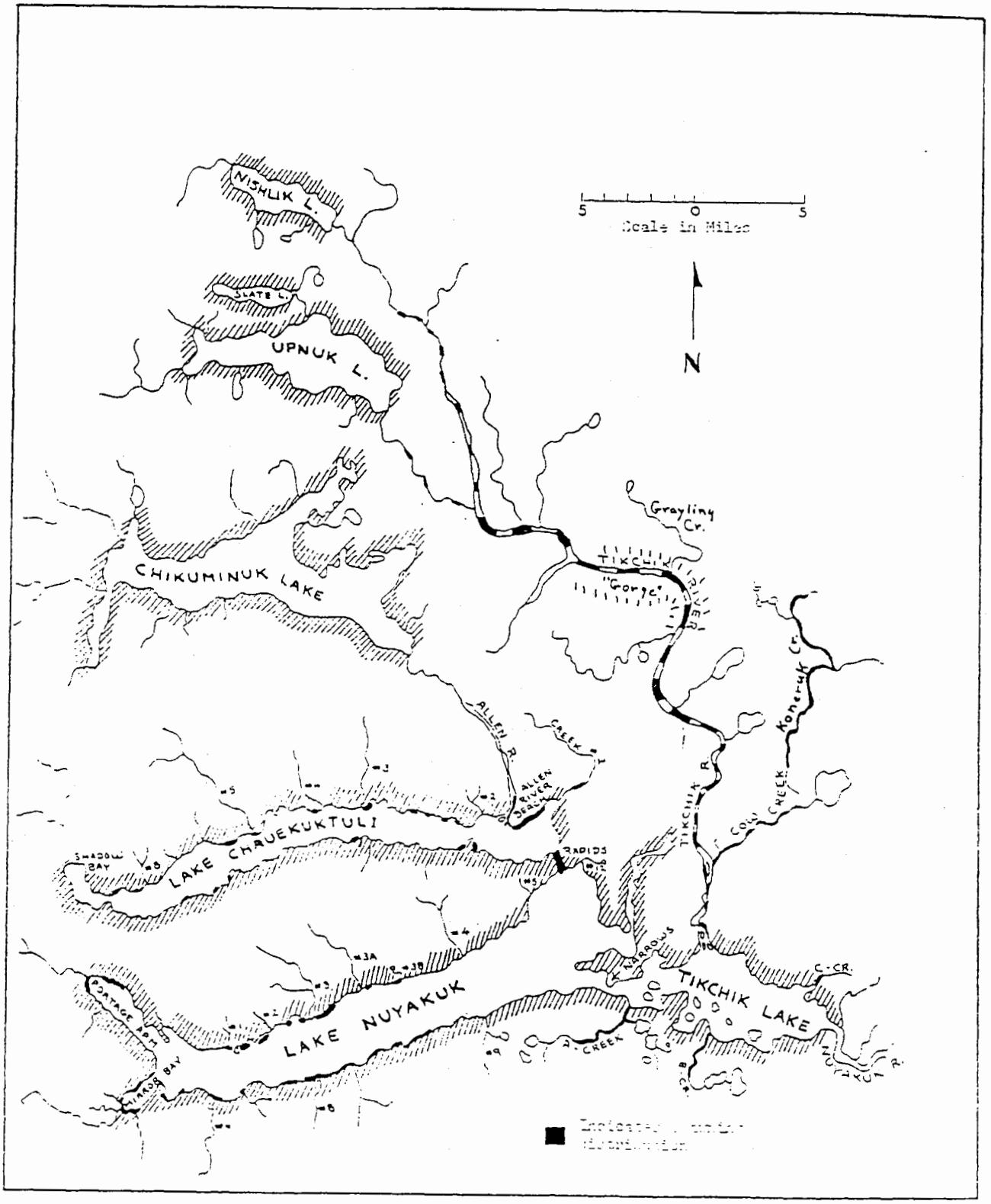

Figure 8. Tikchik Lakes system, Bristol Bay, Alaska.

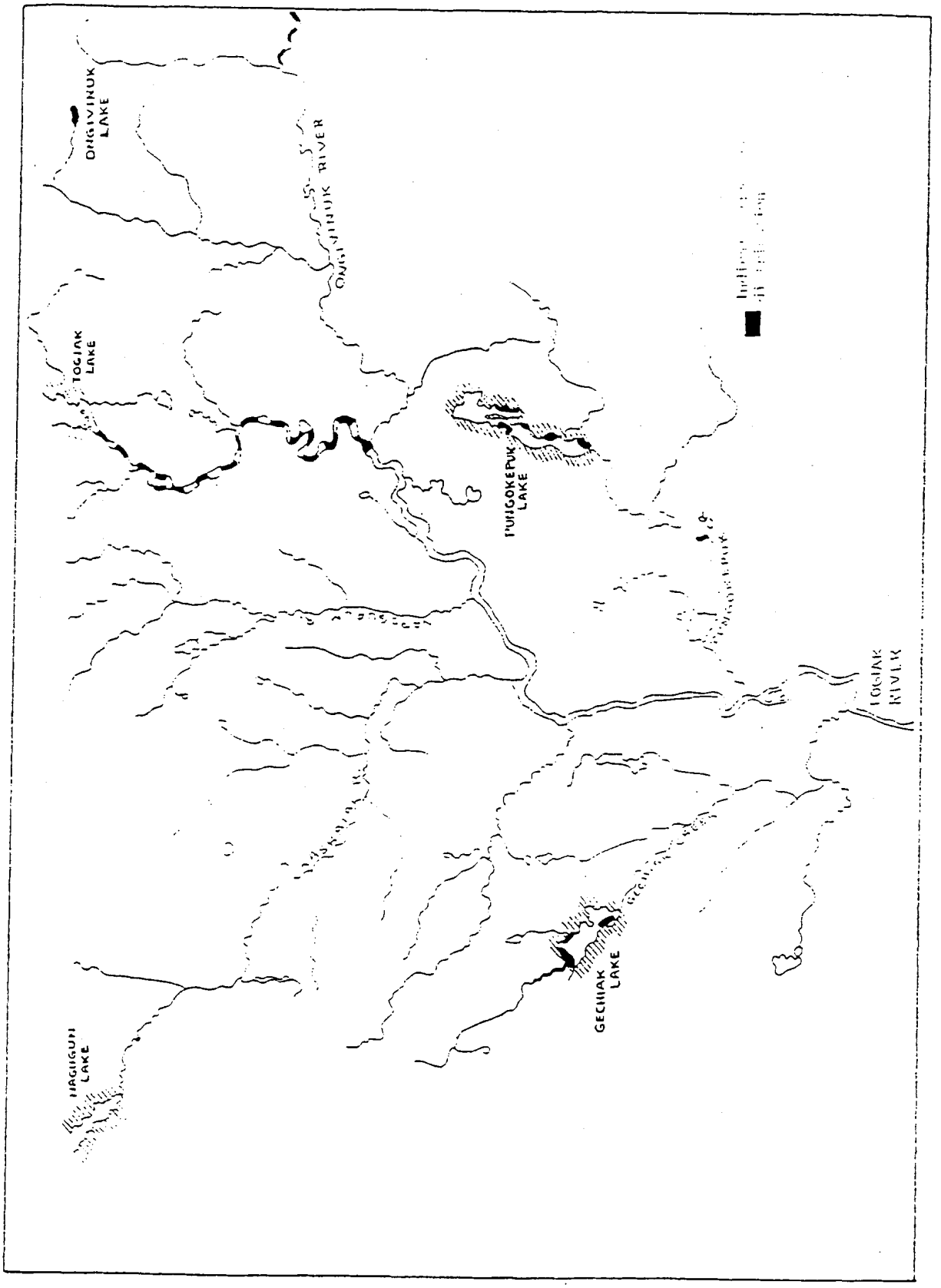

Figure 9. Togiak River system, Bristol Bay, Alaska.

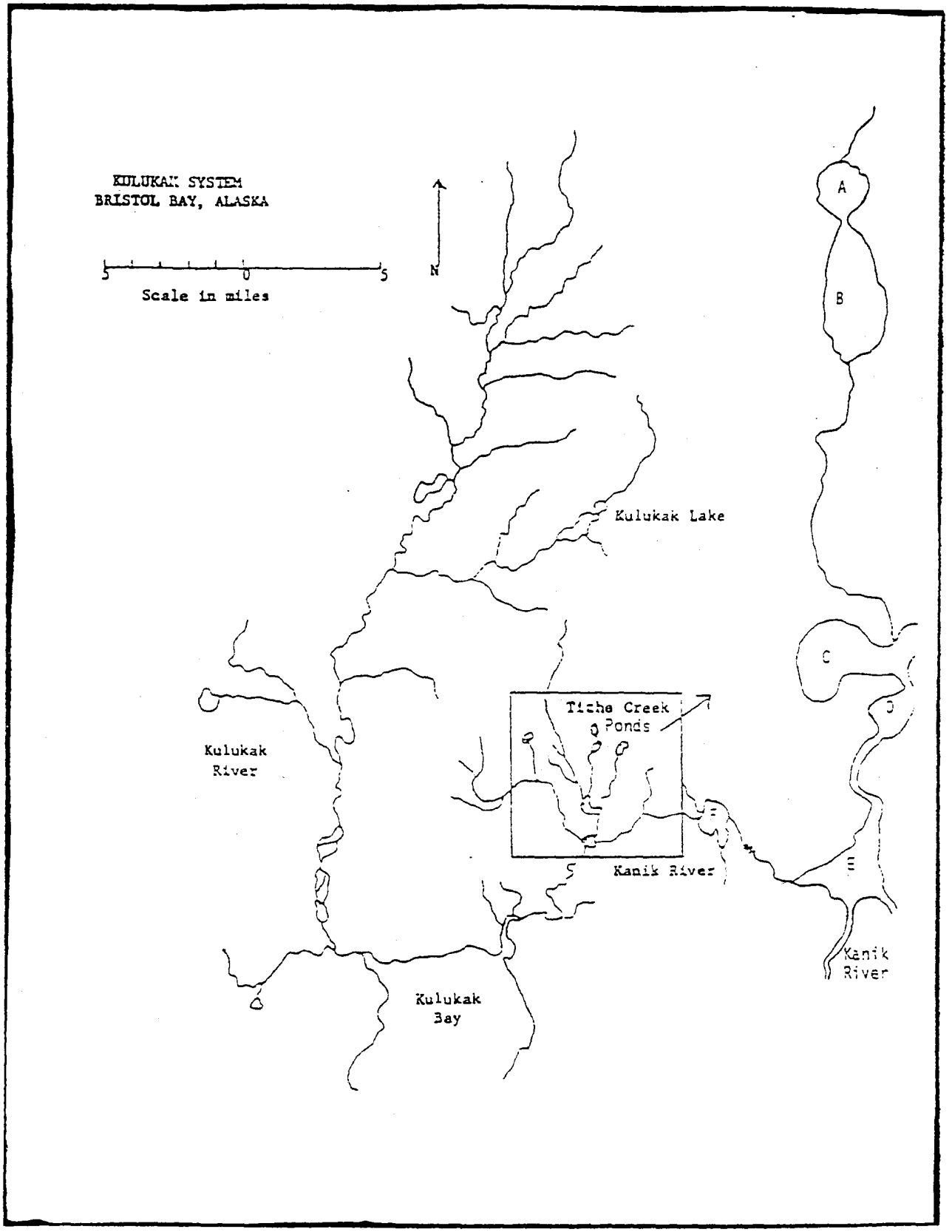

Figure 10. Kulukak River system, Bristol Bay, Alaska.

Appendix Table 1. Sockeye salmon total escapement estimates, Naknek-Kvichak District, 1955-1999. Estimates based on visual counts from towers unless otherwise noted.

Year	Kvichak	Naknek	Alagnak	Total	Alagnak Percent of Total
1955	250,546	278,500 [b]	171,500 [a]	700,546	24
1956	9,443,318	1,772,595 [b]	784,000 [a]	11,999,913	7
1957	2,842,810	634,645 [b]	126,595	3,604,050	4
1958	534,785	278,118	94,650	907,553	10
1959	680,000	2,231,807	825,431	3,737,238	22
1960	14,630,000	828,381	1,240,530	16,698,911	7
1961	3,705,849	351,078	90,036	4,146,963	2
1962	2,580,884	723,066	90,630	3,394,580	3
1963	338,760	905,358	203,304	1,447,422	14
1964	957,120	1,349,604	248,700	2,555,424	10
1965	24,325,926	717,798	175,020	25,218,744	1
1966	3,775,184	1,016,445	174,336	4,965,965	4
1967	3,216,208	755,640	202,626	4,174,474	5
1968	2,557,440	1,023,222	193,872	3,774,534	5
1969	8,394,204	1,331,202	122,490	9,847,896	1
1970	13,935,306	732,502	177,060	14,844,868	1
1971	2,387,392	935,754	187,302	3,510,448	5
1972	1,009,962	586,518	151,188	1,747,668	9
1973	226,554	356,676	35,280	618,510	6
1974	4,433,844	1,241,058	214,848	5,889,750	4
1975	13,140,450	2,026,686	100,480	15,267,616	1
1976	1,965,282	1,320,750	81,822	3,367,854	2
1977	1,341,144	1,085,856	100,000 [a]	2,527,000	4
1978	4,149,288	813,378	229,400 [a]	5,192,066	4
1979	11,218,434	925,362	294,200 [a]	12,437,996	2
1980	22,505,268	2,644,698	297,900 [a]	25,447,866	1
1981	1,754,358	1,796,220	82,210 [a]	3,632,788	2
1982	1,134,840	1,155,552	239,300 [a]	2,529,692	9
1983	3,569,982	888,294	96,220 [a]	4,554,496	2
1984	10,490,670	1,242,474	215,370 [a]	11,948,514	2
1985	7,211,046	1,849,938	118,030 [a]	9,179,014	1
1986	1,179,322	1,977,645	230,180 [a]	3,387,147	7
1987	6,065,880	1,061,806	154,210 [a]	7,281,896	2
1988	4,065,216	1,037,862	194,630 [a]	5,297,708	4
1989	8,317,500	1,161,984	196,760 [a]	9,676,244	2
1990	6,970,020	2,092,578	168,760 [a]	9,231,358	2
1991	4,222,788	3,578,508	277,589 [a]	8,078,885	3
1992	4,725,864	1,606,650	226,643 [a]	6,559,157	3
1993	4,025,166	1,535,658	347,975 [a]	5,908,799	6

(Continued)

Appendix Table 1. (page 2 of 2)

Year	Kvichak	Naknek	Alagnak	Total	Alagnak Percent of Total
1994	8,337,840	990,810	242,595 [a]	9,571,245	3
1995	10,038,720	1,111,140	215,713 [a]	11,365,573	2
1996	1,450,578	1,078,098	306,750 [a]	2,835,426	11
1997	1,503,732	1,025,664	218,115 [a]	2,747,511	8
1998	2,296,074	1,202,172	252,200 [a]	3,750,446	7
1999	6,196,914	1,625,364	463,600 [a]	8,285,878	6
Mean	5,907,202	1,306,788	258,573	7,472,563	6

[a] Aerial survey counts.
[b] Weir counts.

Appendix Table 2. Aerial survey counts of chinook salmon escapements, Naknek River drainage, 1971-1999.

Year	Mainstem Naknek River	Paul's Creek	King Salmon Creek	Big Creek	Total
1971	1,639	52	704	490	2,885
1972	351	156	1,224	1,060	2,791
1973	1,315		115	1,106	2,536
1974		91	495	860	1,446
1975	2,250	144	279	779	3,452
1976	5,950	31	180	970	7,131
1977	4,830		1,860		6,690
1978					[a]
1979					[a]
1980	300	17		30	347
1981	2,890		591	790	4,271
1982	5,360	340	980	1,930	8,610
1983	2,860	290	460	4,220	7,830
1984	790	400	385	3,420	4,995
1985	590				590
1986	2,200	73	102	1,542	3,917
1987	2,800	7	290	1,353	4,450
1988	7,380	150	600	3,600	11,730
1989	1,700	50	100	860	2,710
1990	4,500	150	350	2,000	7,000
1991	1,655	121	275	2,340	4,391
1992	1,550	88	158	895	2,691
1993	5,520	86	700	1,710	8,016
1994	5,970	203	974	2,531	9,678
1995	2,790	26	239	1,905	4,960
1996	2,965	157	312	1,576	5,010
1997	7,520	248	902	1,783	10,453
1998	2,150	210	1,060	2,085	5,505
1999		223	847	2,250	3,320
Mean	3,113	144	567	1,683	5,508 [b]
Percent	57	3	10	31	100

[a] Counts unavailable.

[b] The sum of mean indices.

Appendix Table 3. Chinook salmon escapement survey history, mainstem Naknek River, 1929-1999.

Year	Count Dates	Surveyors	Actual Weir Count [a]	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate [b]	Comments
1929	7/03-7/31		1,498			Chinook count peaked 7/27.
1930	6/20-8/09		1,999			Chinook count peaked 8/09.
1931	6/17-8/09		896			Chinook count peaked 8/07.
1932	6/23-8/10		1,869			
1950	7/08-8/20		3,097			Chinook count peaked 8/09.
1951	6/28-8/07		1,876			Chinook count peaked 8/04.
1952	6/25-8/10		633			Chinook count peaked 8/06.
1953	6/24-8/10		2,074			Chinook count peaked 7/26.
1954	6/20-8/11		3,474			Chinook count peaked 8/10.
1955	6/13-8/17		4,188			Chinook count peaked 8/16.
1956	6/22-8/28		7,378			Chinook count peaked 8/18.
1957	6/28-8/04		8,504			Chinook count peaked 8/03.
1966		Redick				300 were counted 8/26 from a skiff in the Rapids.
1967	Mid-Aug.	Paddock			800	
1968					1,200	Conservative estimate.
1969					1,200	
1970	7/31	Whitehead		845		
	8/03	Siedelman		3,060		Visibility very good. Super-cub.
	8/22	Siedelman		1,540	1,750	Water high & murky. Spawning pre-peak.
	8/22	Whitehead		1,310		
	8/25	Whitehead		2,225		Counting conditions optimal.
	8/25	Siedelman		2,536	2,500	Conditions good. Spawning pre-peak.

(Continued)

Appendix Table 3. (page 2 of 3)

Year	Count Dates	Surveyors	Actual Weir Count [a]	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate [b]	Comments
1971	8/26	Cunningham		1,639		Fish concentrated near Rapids Camp. Few dead.
1972	8/23	Cunningham & McCurdy		351		Poor counting conditions. Post-peak.
1973	8/19	Russell		1,315		Counting conditions good. Peak near at hand.
1974	8/19	Russell			450	Count accuracy questionable. Many fish were deep.
1975	8/17	Russell		2,250		Good viewing, peak near. Still fish spawning 9/08.
1976	8/13	Bill		2,615		Spawning near peak. Very few dead.
	8/16	Russell		5,950	7,250	Pre-peak. Still lots fish holding in large groups.
1977	8/22	Russell		4,830	5,750	Pre-peak. Few dead. Some still holding deep.
1978	8/09	Gwartney			4,000	Near peak.
1983	8/14	Bill		2,860	3,000	Pre-peak. Still fish holding in large groups.
1984	8/14	Bill		790	2,370	
1985	8/06	Bill			600	Pre-peak.
	8/27	Bill		590	700	
1986	8/18	Russell		1,990		Spawning pre-peak. Still many fish holding.
	8/19	Meyer		2,200		Peak of spawning drawing near.
1987	8/19	Meyer		2,800		Pre-peak. Fish still in large groups. Few redds.
	8/28	Bill		2,655	2,855	
1988	8/09	Minard		7,380	7,400	Approaching peak. Most fish on redds.
1989	8/14	Minard		1,700		Fish actively spawning. Few carcasses observed.
1990	8/06	Minard		4,500		
1991	8/20	Russell		1,655		Pre-peak. Still many fish schooled & waiting.

(Continued)

Appendix Table 3. (page 3 of 3)

Year	Count Dates	Surveyors	Actual Weir Count [a]	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate [b]	Comments
1992	8/21	Regnart		877		Water clarity poor in deeper pools.
	8/27	Regnart		1,550		At Peak...all fish on redds.
1993	8/23	Regnart		5,520		Near peak. Still some fish schooled.
1994	8/24	Regnart		5,970		Near peak. Most on redds.
1995	8/21	Regnart		2,790		Near peak. Most on redds.
1996	8/21	Regnart		2,965		At Peak...all fish on redds.
1997	8/16	Regnart		7,520		Near peak. Most on redds.
1998	8/18	Regnart		2,150		At Peak...all fish on redds.
1999	no survey					Survey flown September 8 no count available.
Mean			3,124	2,779		

[a] Weir count did not account for estimated 15-20% of chinook that spawn downstream of weir site. Also does not account for fish that migrated upstream past the weir site before and after weir operation.

[b] Surveyor's subjective estimate of instantaneous population of chinook salmon spawners in the river at time of aerial survey, based on survey conditions, river area coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for counting at time of survey.

Appendix Table 4. Chinook salmon escapement survey history, Big Creek, Naknek River Drainage, 1963-1999.

Year	Count Dates	Surveyors	Float Count	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate [a]	Comments
1963	8/01	Paddock		362		Covered only half stream length. Helicopter.
	8/13	Paddock		1,345	2,690	Spawning near peak. Good survey.
1964	7/31	Paddock		484		Survey too early.
	8/15	Siedelman & Williamson		636		Survey fair to good. Near peak. Helicopter.
	8/15-8/18	Siedelman & Williamson	1,130			Peak of spawning over.
1965	8/05-8/08	Andrews	578			Fair survey. Began below Index Area No. 1.
1966	8/13-8/16	Redick	979			Spawning at peak. Included Index Area No. 1. Count affected by rain/turbid water in lower areas.
1967	8/10-8/14	Whitehead & Bury	1,129			Upstream redds occupied while those in the lower stream area were abandoned.
1968	8/10-8/14	Meyers & Preyer	3,827			Counting conditions fair to poor.
1969	8/12-8/14	Parkinson & Faro	1,012			High murky waters hampered float count.
	Mid-Aug.	??			5,000	Flown due to poor count conditions during float.
1970	7/19	Whitehead		825		
	8/15-8/17	Parkinson & Brooks	1,601			High murky waters in lower 2/3 of stream.

(Continued)

Appendix Table 4. (page 2 of 3)

Year	Count Dates	Surveyors	Float Count	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate [a]	Comments
1971	8/13	Cunningham		490	1,200	Only upper 1/3 of stream surveyed due to murky water in lower 2/3.
	8/28	Siedelman		277		Past peak. Survey affected by winds of 30+ mph.
1972	8/08	Cunningham		695		Pre-peak.
	8/18	Siedelman		1,060		Post-peak.
1973	8/17	Russell		1,106		At peak of spawning. Many fish beaten up (fungus).
1974	8/01	Russell		520	850	Pre-peak. No dead chinook. Lots dead chums.
	8/11	Russell		860	1,250	Didn't survey lower 8 miles of creek 8/11. Could add 150 fish to survey as Russell saw that many in the unsurveyed portion from skiff 8/10. Near peak.
1975	8/09	Russell		779		Survey pre-peak.
1976	8/13	Bill		970	1,400	Not total stream coverage due to winds & low fuel.
1983	8/14	Bill		4,220	9,000	
1984	8/08	Bill		3,420	8,800	At peak of spawning.
1985	8/06	Bill			2,900	Survey conditions..high water & gusty winds.
1986	8/08	Meyer		1,542	6,000	Excellent conditions. Fish at spawning peak.
1987	8/21	Meyer		1,353	2,500	
1988	8/09	Minard		3,600		
1989	8/14	Minard		860		
1990	8/06	Minard		2,000		
1991	8/12	Regnart		2,340		At spawning peak..all fish on redds, only 20 dead.
1992	8/18	Regnart		895		Est. 5-6 days post-peak. Count includes 125 dead.

(Continued)

Appendix Table 4. (page 3 of 3)

Year	Count Dates	Surveyors	Float Count	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate [a]	Comments
1993	8/17	Regnart		1,710		Estimated survey 3-4 days past peak.
1994	8/16	Regnart		2,531		Est. 2-3 days post-peak. Count includes 159 dead.
1995	8/15	Regnart		1,905		Estimate survey was several days past peak.
1996	8/12	Regnart		1,576		At spawning peak....38 dead observed
1997	8/7	Regnart		1,783		At spawning peak....48 dead observed
1998	8/18	Regnart		2,085		At spawning peak....no carcasses present
1999		Morstad		2,250		At spawning peak....no carcasses present
Mean			1,465	1,534		

[a] Surveyor's subjective estimate of instantaneous population of chinook salmon spawners in the river at time of aerial survey, based on survey conditions, river area coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for counting at time of survey.

Appendix Table 5. Chinook salmon escapement survey history, King Salmon Creek, Naknek River drainage, 1964-1999.

Year	Count Dates	Surveyors	Float Count	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate [a]	Comments
1964	7/31	Paddock		378		Survey conditions fair. Helicopter.
	8/11	Paddock		55		Visibility poor. Helicopter.
	8/11-8/14	Paddock & Siedelman	104			Peak of spawning long past. Poor survey (turbid).
1966	7/31-8/03	Redick	633			Spawning at or near peak.
1967	7/24-7/26	Paddock	289			Poor visibility. Estimated 600 fish present.
1968	7/17	Whitehead		282		Pre-peak. Helicopter.
	7/17	Meyers		242		Pre-peak. Helicopter.
	7/20	Whitehead		868		Optimum coditions. Count from H-21 Helicopter.
	7/20	Meyers		575		Optimum coditions. Count from H-21 Helicopter.
	7/20-7/23	Whitehead & Meyers	2,204			Counting conditions optimum.
1969	7/23-7/25	Parkinson & Berry	2,722			Pre-peak. Count fair-to-poor last 2 days (weather).
1970	7/19	Whitehead		260		Counting conditions poor. Pre-peak.
1971	7/28	Cunningham		704		Visibility was good.
1972	7/29	Siedelman		1,224		Peak of spawning.
1973	8/01	Siedelman		115		Visibility only fair. Survey possibly post-peak.
1974	7/15	Russell		164	350	Pre-peak. Many fish holding in pools.
	7/28	Russell		495	625	At or near peak. Only one carcass obsd. Good vis.
1975	7/28	Russell		279	375	Survey pre-peak. Good viewing conditions.
	8/10	Russell	67			Floated only lower 12 miles of creek.
	8/17	Russell		0		Excellent viewing conditions. Spawning is done.
1976	8/03	Bill		180	400	Peak within next 3 days.
1977	7/29	Russell		1,860	2,350	At peak of spawning.

(Continued)

Appendix Table 5. (page 2 of 2)

Year	Count Dates	Surveyors	Float Count	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate [a]	Comments
1978	8/09	Gwartney			350	Past peak. Viewing good. Most fish dead or spent.
1979	??	Gwartney			1,750	
1980	8/08	Bill				Creek too high & muddy to census.
1981	7/30	Russell		591	1,500	Peak of spawning in progress. Vis = fair-to-poor.
1982	8/07	Bill		980	3,920	Good visibility.
1983	8/14	Bill		460	1,400	Poor visibility. Muddy. 30% spawners dead already.
1984	8/08	Bill		385	1,155	
1988	8/08	Minard		600		At peak.
1989	8/14	Minard		100		Past peak.
1990	8/06	Minard		350		
1991	7/30	Russell		100		Pre-peak and water clarity only "Fair".
	8/05	Russell		275		Est. at spawning peak, most fish on redds, 2 dead.
1992	8/09	Russell		158		Post-peak as 47 dead counted & aband. redds numerous.
1993	7/31	Russell		700	900	Slightly pre-peak. Most fish on redds. Water clear.
1994	7/29	Russell		974		Slightly pre-peak. Most fish on redds. Only 6 carcasses.
1995	8/05	Russell		239		A little past peak. Several singles on redds. Vis. only
1996	8/05	Regnart		312		Slightly post peak. 26 dead counted.
1997	7/18	Regnart		902		Pre-peak and water clarity "Good".
1998	8/18	Regnart		1,060		Estimate is at peak of spawn.
1999	8/02	Morstad		847		Estimate near peak of spawn, fair to good conditions.
Mean			1,190	506		

[a] Surveyor's subjective estimate of instantaneous population of chinook salmon spawners in the river at time of aerial survey, based on survey coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for conditions, river areacounting at time of survey.

Appendix Table 6. Chinook salmon escapement survey history, Paul's Creek, Naknek River drainage, 1971-1999.

Year	Count Dates	Surveyors	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate [a]	Comments
1971	7/28	Cunningham	52		
1972	7/28	Siedelman	156		Prior to peak.
1973	8/01	Siedelman			Too murky to survey.
1974	7/15	Russell	2		
	7/26	Russell	91	250	Prior to spawning peak.
1975	7/28	Russell	144	225	Prior to peak. Good conditions.
1976	8/03	Bill	31	100	Poor conditions. Fish paired & spawning.
1977					No count.
1978	8/09	Gwartney		300	Past peak. 75% of fish dead.
1979					No count.
1980	8/08	Bill	17		All carcasses. Creek high & muddy.
1981					No count.
1982	8/07	Bill	340	1,020	Good visibility. Spawning near peak.
1983	8/14	Bill	290	800	Poor visibility.
1984	8/08	Bill	400	800	Fair visibility. About 25% dead already.
1985	8/06	Bill		170	Pre-peak.
1986	8/08	Meyer	73	236	Approximately 30% dead already.
1987	8/13	Russell	7		Poor survey conditions. Past peak.
	??	Meyer		400	Estimat 400 present based on jet boat surveys.
1988	8/08	Minard	150		At peak.
1989	8/14	Minard	50		Past peak. Excellent visibility.
1990	8/06	Minard	150		Excellent survey conditions.

(Continued)

Appendix Table 6. (page 2 of 2)

Year	Count Dates	Surveyors	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate [a]	Comments
1991	7/30	Russell	121		Slightly pre-peak. Only 1 carcass noted.
1992	8/01	Russell	88		Slightly pre-peak. Stream clarity only "Fair".
1993	7/31	Russell	86	140	Slightly pre-peak. Overflew approx 60% of stream.
1994	7/29	Russell	203	300	Pre-peak...but many fish on redds.
1995	8/05	Russell	26		Water clarity poor. 5 carcasses noted
1996	8/05	Regnart	157		Peak of spawning. 12 dead counted.
1997	7/18	Regnart	248		Pre-peak. Excellent visibility
1998	8/18	Regnart	210		
1999	8/02	Morstad	223		Pre spawning, 10% on redds and two carcasses
Mean			138		

[a] Surveyor's subjective estimate of instantaneous population of chinook salmon spawners in the river at time of aerial survey, based on survey conditions, river area coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for counting at time of survey.

Appendix Table 7. Chinook salmon escapement survey history, Alagnak River, 1963-1999.

Year	Count Dates	Surveyors	Float Count	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate [a]	Comments
1963	8/12	Siedelman		551		Excellent conditions. No side channels flown.
1966	8/06	Redick		13		Poor conditions.
	8/06-8/10	Redick	238			Nonvianuk & mainstem portions only (not Kukaklek).
	8/11	Redick		1,465		Pre-peak. Still many fish upmigrating.
1967	8/16	VanValin		1,250		
1968	8/18	Siedelman		6,717	8,500	Fairly good survey.
1969	8/19	Siedelman		4,781	6,000	Marginal survey conditions, (20kn NW winds).
1970	8/22	Siedelman		5,250	5,000	Peak of spawning. Visibility good
	8/22	Whitehead		4,590		Peak of spawning. Visibility good
1971	8/25	Siedelman		1,420	1,500	Water high, but count okay.
	8/25	Cunningham		1,475		
1972	8/23	Cunningham		2,256	2,400	Past peak. Many dead. Many unoccupied redds.
1973	8/16	Russell		824	1,250	Near peak of spawning. No dead though.
1974	8/13	Russell		1,411	1,700	Pre-peak.
	8/19	Russell		1,596	1,900	Spawning near peak.
1975	8/17	Russell		6,620	7,250	About a week pre-peak. Some large groups holding.
1976	8/16	Bill		7,593	8,750	Pre-peak. Not many dead yet.
1977	8/18	Bill		3,634	12,000	Pre-peak. Didn't count river below Pfaff Pond.
	8/18	Sanders		9,425		Pre-peak. Didn't count river below Pfaff Pond.
1978	8/24	Bill		11,650	25,100	
1979						No survey.
1980	8/08	Bill		2,020	5,090	Pre-peak. Fog over lower river.
	8/21	Bill		2,930	5,860	
1981	8/26	Bill		2,430	8,540	

(Continued)

Appendix Table 7. (page 2 of 2)

Year	Count Dates	Surveyors	Float Count	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate [a]	Comments
1982	8/09	Bill		3,400	4,700	At least a weak too early.
	8/19	Bill		3,350	5,480	Peak survey.
1983	8/15	Bill		2,980	3,500	At peak of spawning.
1984	8/14	Bill		6,090	9,135	
1985	8/17	Bill		3,920	9,518	About peak for chinook spawning. 30% dead already.
1986	8/11	Bill		3,090	7,200	Peak of spawning.
1987	8/22	Bill		2,420		
1988	8/12	Bill		4,600		
1989	8/15	Bill		3,650		
1990	8/08	Bill		1,720		
1991	8/09	Regnart		2,023		Pre-peak. Most fish schooled yet. Few on redds.
	8/19	Regnart		2,531		Near peak. Most fish on redds.
1992	8/10	Regnart		3,042		Pre-peak. Most fish still schooled.
	8/21	Regnart		2,275		Near peak...but water clarity worse than earlier.
1993	8/09	Regnart		10,170		Near peak. Most on redds.
1994	8/08	Regnart		8,480		About half the fish on redds. Others schooled.
1995	8/10	Regnart		6,860		About 2/3 of chinook noted on redds.
1996	8/12	Regnart		9,885		Near peak. Most on redds.
1997	8/7	Regnart		15,210		Peak. Excellent visibility
1998	8/12	Anderson		4,148		About 1/3 of braids poor light; most on redds.
1999	8/10	Morstad		2,178		Peak of spawning, good survey conditions
Mean			238	4,231		

[a] Surveyor's subjective estimate of instantaneous population of chinook salmon spawners in the river at time of aerial survey, based on survey conditions, river area coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for counting at time of survey.

Appendix Table 8. Chinook salmon escapement survey history, Kvichak River, 1932-1999.

Year	Count Dates	Surveyors	Weir Count	Non-expanded Aerial Index Count	Expanded Aerial Inde Estimate [a]	Comments
1932	6/28-8/5		5,753			Peak count was on 7/05 (1,168 fish).
1976	8/16	Bill		35	45	Survey timed to count pink salmon.
1980[b]	8/08	Bill		900	1,000	Chinook actively spawning.
1984	8/14	Bill		200		
1988	8/13	Bill		190	570	Nearly all on redds.
1989	8/16	Bill		100	260	
1990	8/19	Bill		170	510	
1992	8/13	Regnart		264		All fish on redds in Kaskanak Flats.
1993	8/16	Regnart		115		All fish on redds in Kaskanak Flats.
1994	8/12	Regnart		306		
1995	8/14	Regnart		96		
1996	8/18	Regnart		132		
1997	8/15	Regnart		103		
1998	8/14	Anderson		187		All fish on redds in Kaskanak Flats
1999	8/10	Morstad		1,200		
Mean			5,753	286		

[a] Surveyor's subjective estimate of instantaneous population of chinook salmon spawners in the river at time of aerial survey, based on survey conditions, river area coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for counting at time of survey.

[b] Pecks Creek, a Kvichak River tributary, was float surveyed 7/30-8/03, 1980 by R. Russell and 99 spawning chinook salmon were counted.

Appendix Table 9. Chinook salmon escapement data, Naknek-Kvichak District, 1970-1999.

Year	Non-expanded Escapement Indices by Drainage [a]			Total
	Naknek	Alagnak	Kvichak	
1970	4,145 [b]	5,250		9,395
1971	2,885	1,420		4,305
1972	2,791	2,256		5,047
1973	2,536 [b]	824		3,360
1974	1,446 [c]	1,596		3,042
1975	3,452	6,620		10,072
1976	7,131	7,593	35	14,759
1977	6,690 [b]	3,634		10,324
1978	[d]	11,650		11,650
1979	[d]	[d]		0
1980	347 [e]	2,930	900	4,177
1981	4,271 [b]	2,430		6,701
1982	8,610	3,400		12,010
1983	7,830	2,980		10,810
1984	4,995	6,090	200	11,285
1985	590 [f]	3,920		4,510
1986	3,917	3,090		7,007
1987	4,450	2,420		6,870
1988	11,730	4,600	190	16,520
1989	2,710	3,650	100	6,460
1990	7,000	1,720	170	8,890
1991	4,391	2,531		6,922
1992	2,691	3,042	264	5,997
1993	8,016	10,170	115	18,301
1994	9,678	8,480	306	18,464
1995	4,960	6,860	96	11,916
1996	5,010	9,885	132	15,027
1997	10,453	15,210	103	25,766
1998	5,505	4,148	187	9,840
1999	3,320 [c]	2,178	1,200	6,698
Mean [g]	5,105	5,164	100	10,369

[a] Includes aerial indices from all streams surveyed in drainage.
[b] No index count for Paul's Creek.
[c] No index count for Naknek River.
[d] No non-expanded index counts exist for this year.
[e] Includes only index counts for mainstem Naknek River, Paul's Creek, & Big Creek.
[f] Naknek River mainstem only.
[g] Sum of mean indices.

Appendix Table 10. Chum salmon escapement survey history, Alagnak River, 1961-1999.

Year	Count Dates	Surveyors	Tower Counts	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate [a]	Comments
1961			18,906			
1962			3,846			
1963	8/12	Siedelman	20,124	4,120		
1964			2,562			
1965			132			
1966						
1967			9,990			
1968			72			
1969			210			
1970			5,790			
1971			402			
1972			48			
1973						
1974						
1975						
1976	8/16	Bill		2,125	5,250	
1977	8/18	Bill		35,000		
1978	8/24	Bill		9,900		
1979						
1980	8/21	Bill		7,300	14,600	
1981	8/26	Bill		75,000	75,000	
1982	8/09	Bill		14,000	42,000	
	8/19	Bill		12,000	30,000	
1983	8/15	Bill		8,800		Pre-peak.

(Continued)

Appendix Table 10. (page 2 of 2)

Year	Count Dates	Surveyors	Tower Counts	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate [a]	Comments
1984	8/14	Bill		48,000	87,500	
1990	8/08	Bill		8,500	30,000	Pre-peak.
	8/18	Bill		48,800		Close to peak of spawning.
1991	8/09	Regnart		43,000		Pre-peak.
	8/19	Regnart		64,300		Peak of spawning.
1992	8/10	Regnart		114,000		Near Peak.
1993	8/09	Regnart		4,600		Near Peak.
1994	8/08	Regnart		62,900		Near Peak.
1995	8/10	Regnart		132,000		Near Peak.
1996	8/12	Regnart		145,000		Near Peak
1997	8/07	Regnart		37,800		Near Peak
1998	8/12	Anderson		3,150		Poor survey conditions
1999	8/10	Morstad		11,800		Near Peak
Mean			3,575	40,550		

[a] Surveyor's subjective istimate of instantaneous population of chum salmon spawners in the river at time of aerial survey, based on survey conditions, coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for river area counting at time of survey.

Appendix Table 11. Pink salmon escapement survey history, Alagnak River, 1968-1999.

Year	Count Dat	Surveyor	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate [a]	Comments
1968	8/27	Siedelman	97,000	125,000	
1970					No survey.
1972					No survey.
1974	8/14	Bill	20,600		Big schools. Pre-peak.
1976	8/16	Bill	6,375	13,000	Pre-peak.
1978	8/24	Bill	330,300	736,000	Just starting to spawn. Many still in lower river.
1980	8/21	Bill	121,000	242,000	
1982	8/09	Bill	21,300	63,900	
	8/19	Bill	24,800	43,000	Pre-peak.
1984	8/14	Bill	296,500	567,100	Survey too early for peak. Most fish schooled.
1986	8/11	Bill	48,600	145,800	
1988	8/12	Bill	415,000	620,000	Pre-peak.
1990	8/08	Bill	45,100		
	8/18	Bill	240,500		Estimated to be about 1 week pre-peak.
1992	8/10	Regnart	15,000		Pre-peak.
1993	8/09	Regnart			No pinks noted.
1994	8/08	Regnart			No pinks noted.
1995	8/10	Regnart			No pinks noted.
1996	8/12	Regnart			No pinks noted.
1997	8/7	Regnart			No pinks noted.
1998	8/12	Anderson	3,200		High water poor light conditions
1999	8/10	Morstad			No pinks noted.
Mean			146,880		

[a] Surveyor's subjective estimate of instantaneous population of pink salmon spawners in the river at time of aerial survey, based on survey conditions, river area coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for counting a time of survey.

Appendix Table 12. Pink salmon escapement survey history, Kvichak River, 1966-1999.

Year	Count Dates	Surveyor	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate [a]	Comments
1966		Robertson		67,500	
1968	8/26	Siedelman		88,000	
1970					No survey.
1972					No survey.
1974	8/14	Bill		30,560	
1976	8/16	Bill		16,100	Most still schooled.
1978	8/28	Bill	88,000	440,000	Still numerous fish migrating & some schooled.
1980	8/08	Bill	7,000	25,000	Still schooled.
1982					No Survey.
1984	8/14	Bill	111,000	165,000	
1986					No survey.
1988	8/13	Bill	94,000		
1990	8/19	Bill	25,300	47,000	
1992					No survey.
1993					No survey.
1994					No survey.
1995					No survey.
1996					No Survey
1997					No Survey.
1998					No Survey.
1999					No Survey.
Mean			65,060		

[a] Surveyor's subjective estimate of instantaneous population of pink salmon spawners in the river at time of aerial survey, based on survey conditions, river area coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for counting at time of survey.

Appendix Table 13. Pink salmon escapement survey history, Naknek River, 1974-1999.

Year	Count Dates	Surveyor	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate [a]	Comments
1974	8/14	Bill	161,800	362,000	
1976	8/13	Bill	94,600	110,000	Just pre-peak. Many still schooled.
1978	8/24	Bill	312,000	780,000	
1980	8/08	Bill	80,000	160,000	Pre-peak.
1982	8/19	Bill	33,600	34,000	Pre-peak.
1984	8/14	Bill	27,000	125,000	
1986	8/18	Russell	286,000	375,000	Most fish still schooled and holding. Pre-peak.
1988	8/24	Russell	187,000		
1990	8/18	Bill		65,000	
1992					No survey.
1993					No survey.
1994					No survey.
1995					No survey.
1996					No Survey.
1997					No survey.
1998					No survey.
1999					No survey.
Mean			147,750		

[a] Surveyor's subjective estimate of instantaneous population of pink salmon spawners in the river at time of aerial survey, based on survey conditions, river area coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for counting at time of survey.

Appendix Table 14. Aerial survey counts of chinook salmon escapement, Egegik District, 1981-1999.[a]

Year	Egegik River	Shosky Creek	Whale Mountain Creek	Mossy Creek	Mink Creek	Gertrude Creek	Kaye's Creek	Takayoto Creek	Angle Creek[f]	Contact Creek	King Salmon River	Total
1981						515						515
1982	300					900				300		1,500
1983						860		380		375		1,615
1984	40	300				600		350		110		1,400
1985	75	80	0	15	10	260	230	315		95		1,080
1986	65	150	48	0	0	150	46	40		18	15	532[b]
1987	15	174	2	74	0	408	284	232	2	88		1,279
1988	50	151	0	12		248	120	177		110		868
1989	14	90	13	43	7	310	120	300		100		997
1990	24[c]	85	7	35	2	260	175	175		205		968
1991	0[c]	62	60	30	33	83	117	95		73		553
1992[d]	15	143	52	54	22	416	320	190		296		1,508
1993	80	58	6	38	6	350	170	200		235		1,143
1994[d]	66[c]	48	32	118	77	840	214	230		705		2,330
1995[d]	60[c]	32	10	53	103	456	248	130		275		1,367
1996	42[c]	102	8	38	20	230	74	123	6	203		846
1997	30[c]	39	2	18	10	260	173	374		740		1,646
1998	0[c]	29	45	55		320	165	120		329		1,063
Average	55	103	20	42	24	415	175	214	4	250		1,178
1999	6[c]	75	10	51		165	6	115		145		573
Deviation[e]	-89%	-27%	-51%	22%		-60%	-97%	-46%		-42%		-51%

[a] Peak aerial counts unless otherwise noted. Data not expanded.
[b] Survey 10-14 days later than normal.
[c] Tower count.
[d] Helicopter surveys.
[e] 1999 deviation from 1981-1998 average.
[f] Angle Creek is usually too turbid to survey.

Appendix Table 15. Aerial survey counts of chum salmon escapement, Egegik District, 1982-1999. [a]

Year	Egegik River	Shosky Creek	Whale Mountain Creek	Mossy Creek	Mink Creek	Gertrude Creek	Kaye's Creek	Takayoto Creek	Angle Creek[b]	Contact Creek	King Salmon River	Total
1982						12,000				2,000		14,000
1983	6 [c]					5,000		3,500		6,000		14,500
1984	800	200				13,000		2,400		10,000		26,400
1985	400	0	600	200	35	2,600	800	0		500	50	5,185
1986	0	0	6,025			140	3	5	0	15	25	6,213 [d]
1987	150	0	19,000	16	1,000	3,770	2,780	0		2,850		29,566
1988	500	50	4,400	100	50	5,200	1,600	0		3,200		15,100
1989	0	10	3,200	25	100	1,100	0	0		200	14	4,649
1990	72 [c]	0	2,000	0	150	1,675	80	0		750		4,727
1991	0 [c]	0	1,500	70	100	990	280	0		480		3,420
1992[e]	50	0	680	15	25	4,500	400	0		3,630	200	9,500
1993	100	0	1,020	8	1	1,075	0	0		100		2,304
1994[e]	42 [c]	0	1,700	5	7	760	175	30		260		2,979
1995[e]	144 [c]	2	395	15	30	560	162	5		600		1,913
1996	12	0	438	4	20	530	0	24	0	633		1,661
1997	0 [c]	0	220	8	10	495	290	60		640		1,723
1998	17 [c]	8	1,480	4		920	4	4		140		2,577
Average	152	18	3,047	36	127	3,195	470	377	0	1,882	72	8,613
1999	6 [c]	0	1,040	4	0	243	0	4		140		1,437

[a] Peak aerial counts unless otherwise noted. Data not expanded.
[b] Angle Creek is usually too turbid to survey.
[c] Tower count.
[d] Survey 10-14 days later than normal.
[e] Helicopter surveys.

Appendix Table 16. Aerial survey counts of pink salmon escapement, Egegik District, 1974-1999.[a]

Year	Egegik River	Whale Mountain Creek	Gertrude Creek	Contact Creek	Takayoto Creek	Kaye's Creek	Other	Total
1974	3,912 [b]							3,912
1976	0 [b]							0
1977	84 [b]							84
1980	0 [b]							0
1982	15,000							15,000
1983			58 [c]					58
1984	17,000							17,000
1985								
1986	2,500							2,500
1987								
1988	23,000							23,000
1989	300							300
1990	17,000		40 [c]					17,040
1991		88 [d]	24 [d]	36 [d]				148
1992[e]	6 [b]	10					3	13
1993	50							50
1994	21,282 [b]							21,282
1995	24 [b]							24
1996	103,116 [b]							103,116
1997	0 [b]		1,290 [f]					1,290
1998	2 [b]		2,487 [f]					2,489
Average	14,518	49	780	36			3	10,911
1999	6 [b]		1,125 [f]					1,131

[a] Non-expanded aerial peak counts unless otherwise noted.
[b] Tower counts.
[c] Float count.
[d] Foot survey (USFWS).
[e] Helicopter surveys.
[f] Gertrude Creek Weir count.

Appendix Table 17. Aerial survey counts of coho salmon escapement, Egegik District, 1981-1999.

Year	Number of Surveys	Coho Salmon Count	Comments
1981	1 [a]	4,000	Only Becharof tributaries surveyed.
1982	1	20,000	Surveyed on August 20.
1983	0	0	No surveys done.
1984	3	43,225	40,000 counted in Egegik Lagoon on August 15.
1985	3	5,260	Peak surveys on August 26.
1986	1	12,575	Surveyed August 19.
1987	6	6,930	Included King Salmon River & tributaries.
1988	6	13,715	Included King Salmon River & tributaries.
1989	9	4,485	Included Gertrude & Whale Mountain Creeks.
1990	7	13,400	Peak survey on August 17.
1991	0	220	Incidental observation made August 6.
1992 [b]	0	200	Incidental observation in Egegik River August 6.
1993	0	1,130	Incidental observation from Egegik River August 16.
1994 [b,c]	2	7,412	Included King Salmon River & tributaries.
1995 [d]	2	5,258	Included King Salmon River & tributaries.
1996 [e]	2	9,043	Included King Salmon River & tributaries.
1997	3	4,106	Gertrude Weir Count & selected Becharof Lake tributaries.
1998	1	6,075	Gertrude Weir Count & selected Becharof Lake tributaries.
1999	1	4,353	Gertrude Weir Count & selected Becharof Lake tributaries.

[a] Survey done by USFWS personnel.

[b] Helicopter surveys.

[c] The Egegik River Tower was maintained through September 11 and approximately 10,140 coho salmon were counted.

[d] The Egegik River Tower was maintained through August 30 and approximately 7,470 coho salmon were counted.

[e] The Egegik River Tower was maintained August 7 to September 11 and approximately 24,918 coho salmon were counted.

Appendix Table 18. Aerial survey counts of chinook salmon escapement, Ugashik District, 1980-1999.

Year	Ugashik River	Dog [1] Salmon River	King Salmon	Painter Creed	Pumice Creek	Old Creek	Total
1980	0 [a]		900	1,000			1,900
1981	18 [a]		50	300			368
1982	0 [a]		700	700			1,400
1983	50 [a]	1,635	525	635	1,800	660	5,305
1984	108 [a]	836	4,100	1,875	1,100	880	8,899
1985	150 [b]	560	4,600	410	930	410	7,060
1986	66 [b]	252	1,777	646	705	739	4,185
1987	54 [a]	751	981	1,051	1,602	1,155	5,594
1988	249 [c]	900	5,820	1,170	1,025	660	9,824
1989	226 [bc]	848	1,670	1,030	510	520	4,804
1990	67 [ac]	540	1,500	590	450	610	3,757
1991	131 [ac]	449	700	365	375	420	2,440
1992[d]	260 [ac]	821	1,260	855	750	815	4,761
1993	188 [ac]	579	1,970	865	450	635	4,687
1994[d]	233 [ac]	1,741	2,225	1,005	2,530	1,490	9,224
1995	149 [ac]	882	440	366	501	505	2,843
1996	76 [ac]	1,079	1,200	403	[f]	30 [f]	2,788
1997	839 [ac]	906	802	525	536	558	4,166
1998	458 [ac]	1,411	883	1,230	352	438	4,772
Average	175	887	1,690	791	908	658	4,672
1999	237 [ac]	535	[f]	166	340	213	1,491
Deviation [e]	36%	-40%		-79%	-63%	-68%	-68%

[1] Includes Figure-Eight, Goblet, Oldham, and Wandering Creeks.

[a] Tower counts

[b] Tower count plus later aerial survey counts of main river.

[c] Survey included Grassy Creek (tributary downstream of Ugashik Lagoon).

[d] Helicopter surveys.

[e] 1999 deviation from 1980-1998 average.

[f] Water was too turbid to see fish.

Appendix Table 19. Aerial survey counts of chum salmon escapement, Ugashik District, 1980-1999.

Year	Ugashik River	Dog [1] Salmon River	King Salmon River	Painter Creek	Pumice Creek	Old Creek	Other	Total
1980	18 [a]		7,000	3,000				10,018
1981	0 [a]		200					200
1982	12 [a]		19,000	35,000			650	54,662
1983	0 [a]	1,650	2,700	4,000	20,000 [b]	3,300		31,650
1984	132 [a]	750	119,000	16,000	16,000	14,500	2,500	168,882
1985	42 [c]	350	20,000	1,925	6,000	670	300	29,287
1986	0 [c]	120	8,650	1,200	2,000	630	125	12,725
1987	130 [c]	340	9,750	2,290	10,340	2,090	40	24,980
1988	752 [c,d]	2,290	25,000	10,500	11,650	5,800	950	56,942
1989	600 [c,d]	1,005	7,500	3,700	2,200	2,010	625	17,640
1990	312 [c,d]	170	6,200	1,150	1,630	410	10	9,882
1991	315 [c,d]	240	7,400	750	2,550	2,525	130	13,910
1992[e]	510 [a,c,d]	1,210	8,525	4,000	14,000	15,000	0	43,245
1993	93 [c,d]	105	7,000	720	2,040	1,025	8	10,991
1994[e]	66 [a,c]	851	9,150	1,625	12,750	6,975	150	31,567
1995	6 [a,c]	160	3,900	1,370	2,600	1,800	0	9,836
1996	138 [a]	85	16,500	700	7,400	2,500	0	27,323
1997	100 [a,c]	450	10,500	4,200	5,300	9,480	115	30,145
1998	607 [a,c]	840	10,600	3,800	2,000	4,350	224	22,421
Average	202	664	15,714	5,329	7,404	4,567	364	31,911 [f]
1999	278 [a,c]	400	[h]	650	1,660	2,020	50	5,058
Deviation [g]	38%	-40%		-88%	-78%	-56%	-86%	-84%

[1] Includes Figure-Eight, Goblet, Oldham, and Wandering Creeks.
[a] Tower counts
[b] Float count done from a raft.
[c] Survey included Grassy Creek (tributary downstream of Ugashik Lagoon).
[d] Included tower count plus later aerial surver count.
[e] Helicopter surveys.
[f] Average of the sums of indices for all locations.
[g] 1999 deviation from 1980-1998 average.
[h] Water was too turbid to see fish.

Appendix Table 20. Aerial survey counts of pink salmon escapement, Ugashik District, 1980-1999.

Year	Number of Surveys [a]	Pink Salmon Count	Comments
1980	1	2,000	
1982	1	6,000	4,000 in King Salmon River, 2,000 in Painter Creek.
1983	2	803	Survey of Dog Salmon River conducted by USFWS.
1984	3	656	650 counted in King Salmon River during September 21
1985	3	0	
1986	1	350	Observed in King Salmon River on August 19.
1987	2	1	
1988	7	2,800	Peak count on August 23: 2,000 in King Salmon River.
1989	8	50	Observed in Ugashik River on August 9.
1990	5	2,000	Peak count on August 13.
1991	0	660	Ugashik River tower count.
1992 [b]	0	1,728	Ugashik River tower count.
1993	0	0	
1994 [b]	0	425	Observed near Ugashik Lake Outlet on August 11.
1995	0	36	Ugashik River tower count.
1996	0	550	Observed in King Salmon River on August 12.
1997	0	0	
1998	0	57	Ugashik River tower count.
1999	0	6	Ugashik River tower count.

[a] Zero indicates no surveys designated to look for pink salmon and any oberservations recorded would be incidental to surveying for other species.

[b] Helicopter survey.

Appendix Table 21. Aerial survey counts of coho salmon escapement, Ugashik District, 1981-1999.

Year	Number of Surveys	Coho Salmon Counts	Comments
1981	1	13,300	Surveyed on September 7.
1982	1	10,000	Surveyed on August 26.
1983	0		
1984	1	6,100	Surveyed on August 31.
1985	2	18,880	16,500 in King Salmon River on September 12.
1986	2	8,455	Surveyed on August 19 and 25.
1987	2	17,000	16,700 in King Salmon River on August 23.
1988	7	28,280	12,900 in King Salmon River on September 7.
1989	4	11,515	7,615 observed on August 14.
1990	5	12,610	
1991	0	400	Incidental observation made August 12.
1992[a]	0	790	Incidental observation made August 11.
1993	0	705	Incidental observation made August 16.
1994[a]	0	760	Incidental observation made August 11.
1995	0		
1996 [b]	1	8,275	Surveyed on September 27 and 28.
1997 [b]	2	9,400	Surveyed on September 30 and October 17.
1998 [b]	1	1,459	Surveyed on November 19.
1999[b]	1	10,210	Surveyed on October 14.

[a] Helicopter survey.
[b] Surveys are of selected areas in the Ugashik Lakes, King Salmon and Dog Salmon River drainages.

Appendix Table 22. Spawner distribution and total escapement estimates of sockeye salmon, Wood River system, 1959-1999.

Year	Spawner Distribution (%)			Total Escapement[a]
	Creeks	Beaches	Rivers	
1959	32.8	50.3	16.9	2,209,300
1960	27.4	55.5	17.1	1,016,100
1961	11.4	32.3	56.3	460,700
1962	24.0	65.2	10.8	873,900
1963	12.1	68.5	19.4	721,400
1964	18.9	64.0	17.1	1,076,100
1965	40.6	11.1	48.3	675,100
1966	16.4	54.9	28.7	1,208,700
1967	9.3	66.2	24.5	515,800
1968	9.9	50.8	39.3	649,300
1969	8.6	42.4	49.0	604,300
1970	14.0	52.4	33.6	1,162,000
1971	11.2	56.8	32.0	851,200
1972	17.4	45.1	37.5	430,600
1973	11.5	23.9	64.6	330,500
1974	14.1	63.9	22.0	1,708,800
1975	14.5	34.4	51.1	1,270,100
1976	12.7	33.5	53.8	817,000
1977	11.3	39.5	49.2	561,800
1978	14.2	51.3	34.5	2,267,200
1979	7.3	60.4	32.3	1,706,400
1980	20.8	24.5	54.7	2,969,000
1981	23.0	20.7	56.3	1,233,000
1982	14.0	17.2	68.8	976,400
1983	14.3	60.9	24.8	1,361,000
1984	11.4	27.6	61.0	1,002,800
1985	18.6	22.2	59.1	939,000
1986	16.1	23.3	60.6	819,000
1987	27.6	56.1	16.3	1,337,000
1988	31.0	44.4	24.6	866,800
1989	19.6	28.9	51.5	1,186,400
1990				1,069,400
1991			19.0	1,159,900
1992	24.9	56.7	18.4	1,286,300
1993	40.9	34.1	25.0	1,176,100
1994	25.5	36.4	38.1	1,471,900
1995	33.5	52.9	13.6	1,482,200
1996	25.8	39.3	34.9	1,649,600
1997	15.6	60.8	23.6	1,512,400
1998	20.0	66.2	13.8	1,755,800
Mean	19.0	44.0	36.5	1,134,266
1999				1,512,400

[a] Estimated from Wood River tower counts. Rounded to the nearest hundred.

Appendix Table 23. Total escapement estimates of pink salmon, Nushagak and Togiak Districts, 1962-1999.[a]

Year	Nushagak District[b]	Togiak District[c]
1962	543,000	
1964	910,560	
1974	585,520	8,620[f]
1976	863,430	37,570
1978	9,386,480	150,000[f]
1980	2,785,200	102,820
1982	1,656,660	44,300
1984	2,926,450	269,950
1986	72,190[d]	80,000[f]
1988	494,610[d]	142,500[f]
1990	801,730[d]	207,000
1992	[e]	235,000[f]
1994	192,780[d]	88,000[f]
1996	821,312[d]	[e]
1998	132,400[d]	134,780[f]
Mean	1,583,737	125,045
1999	non-pink year, even years only	

[a] Only those years of comprehensive aerial coverage are included: even years only; all counts rounded to the nearest 10 fish.

[b] Includes Wood, Igushik, Snake, Nushagak, and Nuyakuk Rivers, and Ice, Youth, and Sunshine Creeks, unless otherwise noted.

[c] Includes Togiak, Matogak and Osviak Rivers; 1982, 1990 and 1998 also Include Slug River.

[d] Sonar estimate of Nushagak-Mulchatna Rivers only.

[e] No escapement estimate.

[f] Togiak River estimate only.

Appendix Table 24. Aerial estimates of sockeye salmon escapements, Togiak District, 1979 - 1999.[a]

Year	Togiak River & Tributaries[b]	Kulukak Systems[c]
1979	23,700	26,600
1980	50,700	45,700
1981	39,700	58,800
1982	25,300	52,800
1983	13,200	27,000
1984	30,900	49,800
1985	8,800	36,600
1986	35,000	42,800
1987	28,600	37,800
1988	32,400	31,700
1989	19,800	10,800
1990	47,100	49,600
1991	23,700	23,900
1992	16,500	26,400
1993	15,900	31,800
1994	19,420	29,700
1995	25,500	14,600
1996	30,200	19,000
1997	20,600	8,000
1998	21,900	13,000
1979-98 Mean (20-Year)	26,446	31,820
1979-88 Mean (10-Year)	28,830	40,960
1989-98 Mean (10-Year)	24,062	22,680
1999	40,238	12,300

[a] All counts are rounded to the nearest hundred.

[b] Estimates do not include fish spawning above the counting tower (Togiak Lake outlet); estimates for Ungalikthluk, Osviak. Matogak and Slug Rivers are not included in the 1977-94 data as reported in Bristol Bay Data Reports 73 and 81.

[c] Includes Kulukak River, Kulukak Lake, and Tithe Creek Ponds.

Appendix Table 25. Peak aerial counts of live sockeye salmon, Togiak River drainage, 1979 - 1999.

Year	Togiak Mainstem	Gechiak River	Pungokepuk River	Nayorurun River	Kemuk River	Ongivunuck River	Total
1979	7,100	520	750			2,800	11,170
1980	18,600	3,200	2,500	500	3,200	2,000	30,000
1981	14,100	2,700	3,150			3,400	23,350
1982	2,300	3,600	2,500	0	100	4,800	13,300
1983	4,800	1,100	700	0	0	1,200	7,800
1984	10,550	2,800	2,450	0	0	2,300	18,100
1985	1,800	400	500	0	0	1,700	4,400
1986	13,500						13,500
1987	5,200	3,600	600	0	0	4,900	14,300
1988	9,400	2,000	1,100	0	0	3,700	16,200
1989	7,600	1,500	630			150	9,880
1990	8,770	5,720	5,980	0	2,550	1,190	24,210
1991	7,990	1,640	1,220			1,010	11,860
1992	3,030	1,280	1,400			2,200	7,910
1993	2,300	1,270	540			2,950	7,060
1994	3,100	560	1,870			3,900	9,430
1995	3,260	1,745	1,000		4,200	2,330	12,535
1996	9,160	2,270	150	100	240	3,190	15,110
1997	8,200	1,600	450	50	650	2,800	13,750
1998	4,890	3,100	150	10	0	2,800	10,950
Mean	7,283	2,137	1,455	60	912	2,596	14,442 [a]
%	50.4%	14.8%	10.1%	0.4%	6.3%	18.0%	100.0%
1999	5,400	11,275	1,475	100	75	6,700	25,025

[a] Sum of means for all streams.

Appendix Table 26. Peak aerial counts of live sockeye salmon, Togiak District, 1979-1999.

Year	Togiak River [a]	Kulukak River [b]	Tithe Creek Ponds	Quigmy River	Matogak River	Osviak River	Slug River	Negukthlik River	Ungalikthluk River	Total
1979	11,170	4,600	10,800		200	200		600	700	28,270
1980	30,000	12,200	14,200		500	200	1,900			63,500
1981	23,350	15,700	18,250		700	6,400	5,900	3,900	12,800[c]	74,200
1982	13,300	11,900	19,300		0	1,000	5,500	300	2,400	53,700
1983	7,800	8,430	2,720		80	20	2,000	230	940	22,220
1984	18,100	7,400	14,000		200	6,800		100	5,200	51,800
1985	4,400	6,700	11,600		0	200	2,300	260	1,310	26,770
1986	13,500	10,900	14,000							38,400
1987	14,300	10,500	8,400							33,200
1988	16,200	12,600	3,250	250	100	380	5,880	200	2,700	41,560
1989	9,880	2,920	2,500					5,000		20,300
1990	24,210	10,600	14,200	100	400	2,200	3,540	9,700	3,800	68,750
1991	11,860	8,650	3,320	35	860	2,530	560	3,400	2,650	33,865
1992	7,910	7,530	4,950	40	300	3,340	1,460	3,600	3,760	32,890
1993	7,060	9,600	6,300					3,100	5,680	31,740
1994	9,430	10,270	4,600	580	990	1,750	6,070	2,230	3,240	39,160
1995	12,535	3,000	4,310	200	610	1,470	2,820	390	1,720	27,055
1996	15,110	2,490	7,000 [d]		360	780	1,045	1000[d]		26,785
1997	13,750	2,300	3,000		360	780	1,045	1,000		22,235[d]
1998	10,950	2,175	4,300	20	900	2,600	5,010	2,300	240	28,495
Mean	13,741	8,023	8,550	153	410	1,916	3,216	2,136	2,453	40,598 [e]
%	33.8%	19.8%	21.1%	0.4%	1.0%	4.7%	7.9%	5.3%	6.0%	100.0%
1999	25,025	2,950	3,200	290	660	2,210	5,970	1,625	625	42,555

[a] Includes all surveyed sections of Togiak River proper and all tributaries to the Togiak River.

[b] Includes surveys of Kulukak Lake. Counts prior to 1977 include Kulukak Lake only and are not included in the mean.

[c] Includes a combined count for the Negukthlik and Ungalikthluk of 4,500 fish.

[d] Complete count not available

[e] Sum of means for all streams.

Appendix Table 27. Peak aerial counts of live chinook salmon, Togiak River drainage, 1979-1999.

Year	Togiak River Section [a]						Gechiak River	Pungokepuk River	Nayorurun River	Kemuk River	Ongivinuck River	Total
	A	B	C	D	E	F						
1979	370	250	330	150	560	890	1,060	360	250	170	220	4,610
1980	180	120	340	230	120	140	910	200	510	170	190	3,110
1981	420	390	500	200	300	740	980	310	370	390	290	4,890
1982					80	320	470	170	190	130	470	1,830
1983	120	220	370	290	360	850	820	240	340	430	350	4,390
1984	250	560	900	560	820	1,920	760	580	270	580	430	7,630
1985	270	320	640	340	470	970	470	250	290	310	460	4,790
1986	150	80	160	30	110	350						880
1987	20	70	170	120	200	480	610	180	100	120	320	2,390
1988	70	70	160	160	170	710	390	180	60	70	90	2,130
1989	10	30	370			940	190	80			40	1,660
1990	230	170	680	365	805	1,085	370	125	75	400	10	4,315
1991	505	165	475	225	520	455	460	105	90	100	150	3,250
1992	150	250	440	225	450	690	250	160	70	175	105	2,965
1993	170	120	220	160		1,810 [b]	595	240	130	65	440	3,950
1994				215	815	1,580	420	215	225	570	380	4,420
1995	120	220	750	255	800	800	715	140	425	520	295	5,040
1996	75	150	160	100	255	625	335	120	120	235	325	2,500
1997	100	350	1,300	600	820	1,000	275	180	150	275	100	5,150
1998	10	20	250	50	400	1,200	400	150	275	140	275	3,170
Mean	179	198	456	238	448	878	552	210	219	269	260	3,905 [c]
%	4.6%	5.1%	11.7%	6.1%	11.5%	22.5%	14.1%	5.4%	5.6%	6.9%	6.7%	100.0%
1999	150	210	540	510	225	480	365	90	240	305	270	3,385

[a] Section A; Togiak Bay - Gechiak River
Section B; Gechiak River - Pungokepuk River
Section C; Pungokepuk River - Nayorurun River
Section D; Nayorurun River - Kemuk River
Section E; Kemuk River - Ongivinuck River
Section F; Ongivinuck River - Togiak Lake

[b] Includes count for Section E.

[c] Sum of means for all streams.

Appendix Table 28. Peak aerial counts of live chinook salmon, Togiak District, 1979-1999.

Year	Togiak River [a]	Quigmy River	Kulukak River	Matogak River	Osviak River	Slug River	Negukthlik River	Ungalikthluk River	Total
1979	4,610	20	2,260	100	210		850	130	8,180
1980	3,110	0	700	70	40		260	160	4,340
1981	4,890	0	1,290	470	1,730	350	1,460	180	10,370
1982	1,830	90	1,690	290	320		1,600	280	6,100
1983	4,390	40	2,460	190	120		1,080	260	8,540
1984	7,630	30	1,190	150	360		680	20	10,060
1985	4,790	0	540	100	50		80	90	5,650
1986	880								880
1987	2,390		300	30	40		660	80	3,500
1988	2,130	10	490	0	40	0	650	170	3,490
1989	1,660		740				560		2,960
1990	4,315	30	635	75	60	0	930	25	6,070
1991	3,250	25	285	75	100		1,175	55	4,965
1992	2,965	15	485	40	105	30	490	35	4,165
1993	3,950		1,140	80	110	100	830	70	6,280
1994	4,420	20	835	40	60	10	540	190	6,115
1995	5,040	35	430	65	135	50	740	80	6,575
1996	2,500	35	698	35	71	30	402	[b]	3,771
1997	5,150	10	310	50	65	33		10	5,628
1998	3,170	45	375	92	58	39	75	25	3,879
Mean	3,654	25	887	108	204	64	726	103	5,772 [c]
%	63.3%	0.4%	15.4%	1.9%	3.5%	1.1%	12.6%	1.8%	100.0%
1999	3,385	10	240	105	40	150	345	130	4,405

[a] Includes all surveyed sections of Togiak River proper and all tributaries to the Togiak River.
[b] Complete count not available.
[c] Sum of means for all streams.

Appendix Table 29. Peak aerial counts of live chum salmon, Togiak River drainage, 1979-1999.

Year	Togiak River Section [a]						Gechiak River	Pungokepuk River	Nayorurun River	Kemuk River	Ongivinuck River	Total
	A	B	C	D	E	F						
1979	14,000	2,800	3,300	800	6,600	10,400	3,500	1,000	2,500	500	200	45,600
1980	41,300	11,000	9,200	900	6,000	3,100	10,200	2,700	10,100	800	3,500	98,800
1981	11,800	4,500	2,400	1,000	3,000	6,000	3,100	500	4,300	1,700	4,200	42,500
1982				200	1,200	2,500	500	400	1,300	100	1,000	7,200
1983	8,160	3,050	3,780	1,100	2,780	6,070	150	140	5,560	570	3,790	35,150
1984	3,900	6,300	800	0	2,600	6,400	3,700	2,000	4,200	700	3,500	34,100
1985	8,300	6,500	3,200	900	6,700	10,200	4,100	600	9,600	1,800	8,300	60,200
1986[b]												
1987	12,000	9,400	2,700	500	13,200	33,000	2,600	1,200	4,100	700	13,100	92,500
1988	10,000				4,900	3,800	3,700	5,000	3,500	200	3,800	34,900
1989		2,600	2,100		5,000	8,100	290	700			1,200	19,990
1990	2,200	1,275	1,350	400	650	4,200	3,150	1,150	3,400	250	125	18,150
1991	10,200	3,900	2,800	600	5,500	6,000	2,300	500	3,500	800	3,480	39,580
1992[c]	1,800	1,800	300	100	1,200	1,500	2,000	500	1,800	900	800	22,700[d]
1993	6,500	3,500	2,300	60		4,400[e]	1,950	450	4,380	620	3,500	23,260
1994				1,300	5,200	10,400	900	2,400	7,100	900	5,700	33,900
1995	15,700	7,100	4,700	1,800	6,800	5,900	4,800	1,900	9,700	2,700	8,200	69,300
1996	3,700	10,250	5,500	1,300	5,750	8,250	2,600	750	900	550	3,400	42,950
1997	3,900	3,100	3,800	2,750	7,100	4,550	3,200	800	4,750	1,800	3,900	39,650
1998	2,300	1,400	2,750	1,300	4,300	8,950	3,600	1,050	3,000	250	1,650	30,550
Mean	10,264	5,112	3,379	932	5,134	7,657	3,019	1,291	4,817	879	4,030	46,513 [f]
%	262.8%	130.9%	86.5%	23.9%	131.5%	196.1%	77.3%	33.1%	123.4%	22.5%	103.2%	100.0%
1999	3,975	1,950	2,375	1,300	1,725	2,200	1,840	440	4,230	480	2,540	23,055

[a] Section A; Togiak Bay - Gechiak River
Section B; Gechiak River - Pungokepuk River
Section C; Pungokepuk River - Nayorurun River
Section D; Nayorurun River - Kemuk River
Section E; Kemuk River - Ongivinuck River
Section F; Ongivinuck River - Togiak Lake

[b] No aerial surveys conducted.
[c] Counts by section are not representative due to post-peak survey, and are not included in the mean.
[d] Preferred total estimate; management survey count conducted 7/15/92.
[e] Includes count for Section E.
[f] Sum of means for all streams.

Appendix Table 30. Peak aerial counts of live chum salmon, Togiak District, 1979-1999.

Year	Togiak River [a]	Quigmy River	Kulukak River	Matogak River	Osviak River	Slug River	Negukthlik River	Ungalikthluk River	Total
1979	45,600	11,000	16,400	13,400	36,200	4,000	3,800	6,600	137,000
1980	98,800	2,700	27,300	5,700	29,500	6,700	18,500	15,000	204,200
1981	42,500	10,800	11,200	21,700	53,000	3,900	3,800	14,600	161,500
1982	7,200	1,300	8,300	3,100	5,500	2,400	160	1,270	29,230
1983	35,150	4,900	12,960	7,600	11,900	1,210	300	7,360	81,380
1984	34,100	6,300	8,500	10,200	18,400		2,100	3,000	82,600
1985	60,200	1,800	7,800	2,860	5,460	8,800	130	14,650	101,700
1986 [b]									
1987	92,500	1,500	22,000	2,300	2,160				120,460
1988	34,900	10,800	35,000	12,000	17,400	7,600	400	11,300	129,400
1989	19,990	2,820	5,580	7,450	4,900		560		41,300
1990	18,150	555	5,550	1,475	2,300	3,650	750	1,300	33,730
1991	39,580	4,420	9,540	4,730	8,700		120	3,020	70,110
1992	22,700 [c]	600	4,800 [c]	4,400	7,100	1,700	100	4,000	45,400
1993	27,660		6,950	1,970	1,360	3,060	20	4,020	45,040
1994	33,900	890	10,700	1,630	2,000	4,360	230	1,090	54,800
1995	138,600	2,200	7,600	5,200	13,920	6,440	1,000	7,200	182,160
1996	42,950	960	7,560	560	810	2,670	40	[d]	55,550
1997	39,650	1,700	4,550	3,000	2,500	1,890	[b]	[b]	53,290
1998	30,550	2,630	2,700	4,980	3,870	1,060	150	1,300	47,240
Mean	45,509	3,771	11,315	6,013	11,946	3,963	1,787	5,630	89,935 [e]
%	50.6%	4.2%	12.6%	6.7%	13.3%	4.4%	2.0%	6.3%	100.0%
1999	23,055	1,340	3,430	5,700	3,650	4,750	410	11,360	53,695

[a] Includes all surveyed sections of Togiak River proper and tributaries to the Togiak River.
[b] No aerial surveys conducted.
[c] Preferred estimate from a management survey due to post-peak spawning ground survey.
[d] Complete count not available.
[e] Sum of means for all streams.

Appendix Table 31. Peak aerial counts of live coho salmon, Togiak River drainage, 1980-1999.

Year	Togiak River Section [a]						Gechiak River	Pungokepuk River	Nayorurun River	Kemuk River	Ongivinuck River	Total
	A	B	C	D	E	F						
1980	3,620	1,010	1,740	1,270	5,080	1,860	3,460	760	1,310	860	740	21,710
1981	9,280	580	100	800	370	750	520	360	230	210	1,300	14,500
1982	2,200	1,500	150	100	1,400	1,700	1,930	1,740	510	200	11,870	23,300
1983[b]												
1984	1,440	1,190	200	120	620	1,480	4,750	2,240	990	1,110	6,140	20,280
1985	800[c]	660[c]	110[c]	70[c]	150	820	1,340	750	40	80	6,250	9,430
1986			60	400	100	400					2,560	3,520
1987	340	500	250	200	240	530	1,020	70			1,060	4,210
1988	950	370		140	210	360	1,530				4,100	8,590
1989[b]												
1990	1,650	390	400	0	540	660	920	450	260	130	1,730	7,130
1991	4,900[d]	400[d]	700[d]	600[d]	1,680[d]	140					100[d]	140[d]
1992	4,420	1,120	1,180	540	2,940	3,080	5,240	1,440	780	1,500	4,460	26,700
1993[b]												
1994[b]							1,290[d]	220[d]	120[d]	95[d]	1,930	
1995[b]							1,450			200	1,180	
1996	2,550	1,090	150	250	1,600	5,020	2,080	1,170	575	725	6,450	21,660
1997	600	200	400	100	400	1,800	1,000	650	350	475	900	6,875
1998	460	625	100	100	310	1,075	2,550	575	400	500	1,750	8,445
Mean	2,293	715	394	309	1,074	1,503	1,985	850	495	499	3,495	13,565[e]
%	58.7%	18.3%	10.1%	7.9%	27.5%	38.5%	50.8%	21.8%	12.7%	12.8%	89.5%	100.0%
1999	250	75	50	25	100	175	275	35	100	25	175	1,285

[a] Section A; Togiak Bay - Gechiak River
Section B; Gechiak River - Pungokepuk River
Section C; Pungokepuk River - Nayorurun River
Section D; Nayorurun River - Kemuk River
Section E; Kemuk River - Ongivinuck River
Section F; Ongivinuck River - Togiak Lake

[b] No aerial surveys conducted.
[c] Proportional estimates based on 1984 data.
[d] Timing of aerial surveys did not coincide with the period of peak spawning activity, and therefore, counts were not included in the mean or percent.
[e] Sum of means for all streams.

Appendix Table 32. Peak aerial counts of live coho salmon, Togiak District, 1980-1999.

Year	Togiak River [a]	Quigmy River	Kulukak River	Matogak River	Osviak River	Slug River	Negukthlik River	Ungalikthluk River	Total
1980	21,710		10,300						32,010
1981	14,500		3,790				100	840	19,230
1982	23,300		3,380						26,680
1983[b]									
1984	20,280		10,750	1,850	1,080	670			34,630
1985	9,430	200	7,790	610	420				18,450
1986	3,520								3,520
1987	4,210	30	910	440	120			130	5,840
1988	8,590	460	1,840	310	490	470	370	3,170	15,700
1989[b]									
1990	7,130	1,029	5,195	2,675	1,491	810		4,153	22,483
1991	140 [c]		4,200 [c]						4,340
1992	26,700		12,640						39,340
1993[b]									
1994[b]									
1995		855	1,185	1,392	1,080	1,149		5,196 [d]	10,857
1996	21,660	1,211	10,290	3,062	2,805	1,944	851	5,917	47,740
1997	6,875	325	1,675	150	1,046	1,397		1,690	13,158
1998	8,445	390	3,650	1,785	2,001	523	[e]	2,770	19,564
Mean	13,565	563	5,646	1,364	1,170	995	330	2,983	22,086 [f]
%	61.4%	2.5%	25.6%	6.2%	5.3%	4.5%	1.5%	13.5%	100.0%
1999	1,285	169	375	220	213	117	95	450	2,924

[a] Includes all surveyed sections of Togiak River proper and tributaries to the Togiak River.

[b] No aerial surveys conducted.

[c] Timing of aerial surveys did not coincide with the period of peak spawning activity, and therefore, counts were not included in the mean or percent.

[d] Negukthlik and Ungalikthluk Rivers combined.

[e] Complete count not available.

[f] Sum of means for all streams.